Unconscious Rivals

The automatic evaluation of rivals in jealousy-evoking situations

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Chapter 1

Introduction

"If evolution and the survival of the fittest be true at all, the destruction of prey and of human rivals must have been among the most important. . . ."

- William James

An attractive woman walks by and your boyfriend turns his head to look at her. Your girlfriend 'needs to talk to you' and confesses an affair with a co-worker. You are at a party and see someone flirting with your partner. Jealousy is an emotion almost everyone probably has experienced once in his or her life. Throughout history, jealousy has been a favorite topic of playwrights and writers. It was Shakespeare who used, and possibly coined, the metaphor the 'green-eyed monster' in *Othello* (1604) as an allusion to cats and the way they play with their prey before eating it: 'But beware my lord, of jealousy; it is the green-eyed monster which doth mock the meat it feeds on'. To Shakespeare, jealousy was a monster that feeds on love; it mocks it by not trusting it and eventually kills it. Today, jealousy still has a negative connotation. From an early age we are taught that being jealous is wrong and that we should hide the fact that we get jealous now and then. Even today, when almost everything 'goes', most people do not like to admit that they have jealous feelings now and again. Despite the negativity surrounding jealousy, in this thesis I will argue that having jealous feelings is not necessarily bad. Jealousy can actually be a very functional emotion - an emotion that has its roots in our evolutionary history where it had reproductive benefits.

The evolutionary psychological view on jealousy

Evolutionary psychology focuses on the ultimate motives to explain contemporary human behavior, attitudes and emotions. This view of human behavior assumes that human cognitive and motivational functioning is directed by specific functional mental mechanisms which have evolved to solve specific adaptive problems that in human evolutionary history were crucial for survival and reproduction. In other words, some of our social behavior

seems to be 'hard-wired' in our brain – age-old responses that in some cases are not adaptive any more but still persist.

Moreover, the human mind is hypothesized to have evolved to be especially responsive to contextual stimuli that are relevant to fundamental motives like survival or reproduction (Maner, Gailliot, Rouby & Miller, 2007; Neuberg, Kenrick, Maner & Schaller, 2005). Whenever such stimuli are detected, content-specific adaptive mechanisms are triggered – emotions, attitudes or behavior. For example, Schaller, Park & Faulkner (2003) showed that people in a dark room – a situation that heuristically would suggest a vulnerability to harm – are more likely to perceive ethnic outgroup members in a stereotypic manner, e.g. as hostile and threatening. Similarly, since mating is a fundamental human goal, contextual cues are able to trigger cognitive mechanisms that are associated with reproductive success. For example, several studies have shown that especially physically attractive women capture the eye of men as well as women (Maner, Kenrick, Becker, Delton, Hofer, Wilbur, & Neuberg, 2003; Buss, 1989). Maner et al. (2003) showed that both male and female participants overestimated the frequency of attractive faces in an array of pictures of women when they were given insufficient time to process all the faces thoroughly. Moreover, in a recognition memory task, participants showed biased recognition memory for attractive women as opposed to unattractive women. In this case, then, physical attractiveness triggered mating-related motives. Similarly, in an experiment by Roney (2003), young men who were visually exposed to young women reported more favorable attitudes to material wealth, reported greater feelings of ambition and aggressiveness and described themselves as more extraverted than men exposed to other men or men exposed to older women. That is, in their self-reports, these men 'conformed' to women's preferences for socially dominant and high-status males. Interestingly, the men were not aware of the experimental manipulation. Roney (2003) suggests: "[...] This study shows that visual stimuli from potential mates act as input cues, capable of priming psychological changes likely to underlie behavioral courtship tactics" (p. 401).

Likewise, some emotional states act as signals that specific kinds of agonistic or avoidant behaviors would be functional in the current situation. The classic example is a snake-like object triggering an emotional response – fear – which in turn leads to a behavioral response: to flee the dangerous situation. Evolutionary psychologists argue that

the adaptive function of jealousy is the maintenance of the pair bond, since this not only increases the survival chances of individuals, but also of their offspring. Protecting your mate from interlopers is therefore important, and evolutionary psychologists hypothesize that those individuals who were the most sensitive to threats to their relationship would have been reproductively more successful (Buss, 1994). In general, jealousy can be conceptualized as one part of a coordinated system of cognitive, affective, physiological and behavioral responses aimed at guarding one's mate from potential intrasexual competitors which, ultimately, is of importance to reproductive success (Maner & Shackelford, 2007; Buunk, Massar & Dijkstra, 2007; Buss, 1994; Daly, Wilson, & Weghorst, 1982). In general, no sex differences in the intensity of jealousy have been found – when confronted with a jealousy evoking situation, men and women report equal amounts of jealousy (Bringle & Buunk, 1985; Pines & Friedman, 1998). However, when contextual factors are taken into account, sex differences in jealousy do emerge. In this thesis I will focus on one contextual factor in particular: the characteristics of the rival.

Rivals

As was already mentioned, the defining feature of a jealousy-evoking situation is that it involves a rival who is interested in one's partner, or in whom one's partner is interested. Individuals do not become jealous when their mate ends the relationship for other reasons, such as when the partner moves far away for work, or ends the relationship without getting involved with someone else (Mathes, Adams, & Davies, 1985; Parrott, 1991). In a study by Hupka, Otto, Tarabrina, and Reidl (1993) the centrality of a rival for the occurrence of jealousy was illustrated when participants from Russia, the US and Germany agreed that the words 'rival' and 'sex' were associated strongly with jealousy, but not with emotions such as anger, envy, and fear.

According to parental investment theory (Trivers, 1972), when a rival tries to interfere with their relationship, women are at risk of losing access to resources and protection. Men, on the other hand, risk paternity uncertainty, and thus the risk of investing their resources in a child that is not genetically theirs. Thus, when confronted with a real or imagined rival, it is important to assess the actual threat this rival poses to one's relationship. Previous studies have shown that this will be done in particular by making

comparisons between the self and the rival on dimensions that contribute to a rival's attractiveness as a partner to the opposite sex, i.e. their mate value (Gilbert, Price, & Allan, 1995; DeSteno & Salovey, 1996; Dijkstra & Buunk, 1998, 2002; Broemer & Diehl, 2004). Since men and women differ in the things they value in a mate, it can be expected that they also differ in the characteristics of a rival that would evoke their jealousy (Dijkstra & Buunk, 2002; Buss, Shackelford, Choe, Dijkstra, & Buunk, 2000). A woman's mate value is largely determined by her physical attractiveness (Buss, 1989; Kenrick, Sadalla, Groth, & Trost, 1990), which is assumed to signal fertility and health. Men are assumed to value these traits in a woman since men would be most likely to pass on their genes with a fertile woman (Buss, 1989; Kenrick et al., 1990). On the other hand, women seem to have an evolved preference for men who are able to provide them and their offspring with sufficient resources and protection. Therefore, a man's mate value is determined for a large part by characteristics that signal high social status and resources, or by traits that signal his abilities to acquire them, such as assertiveness and self-confidence (Buss, 1989, 1994; Kenrick et al., 1990; Fletcher, Tither, O'Loughlin, Friesen & Overall, 2004). Women also value physical characteristics that signal a male's status or dominance, such as height, muscularity and broad shoulders (Schmitt, 2005; Buss 1994; Buss & Schmitt, 1993). Thus, these features may also in part evoke men's jealousy.

Several studies have been carried out that have found support for the hypotheses stated above. Dijkstra and Buunk (2002) carried out an exploratory study in both a student and a community sample and found that in both samples, women more than men indicated they would experience more jealousy about a physically attractive rival, whereas men indicated that a socially or physically dominant rival, and a rival with a higher status than themselves would evoke their jealousy. Next, in a series of experiments, Dijkstra and Buunk (1998, 2001) confronted participants with a jealousy-evoking scenario, describing a flirtation between their partner and a rival. Participants received one of four profiles of the individual flirting with their partner, consisting of a picture and a personality description. The picture showed an individual of either high or low physical attractiveness, and the personality description depicted someone who was either high or low in dominance in terms of characteristics such as being a good judge of character, taking initiative, influencing people, and livening things up at parties. When indicating their response to the jealousy

evoking situation, the results consistently showed that women reported more jealousy when they had seen the picture of the attractive woman next to the jealousy-evoking scenario. On the other hand, the socially dominant rival evoked most jealousy in male participants (Dijkstra & Buunk, 1998). This same pattern of results was also found in several other cultures, including Korea and the United States (Buss, Shackelford, Choe, Dijkstra, & Buunk, 2000). Even more compelling evidence for the assumption that there are sex differences in the rival characteristics that evoke jealousy comes from studies with homosexual participants (Buunk & Dijkstra, 2001; Dijkstra & Buunk, 2002, Study 4). Although homosexual men and women's mate preferences are similar to those of heterosexual men and women – that is, they are interested in physically attractive and socially dominant partners respectively – their jealousy responses show a different pattern. In an experiment Buunk and Dijkstra (2001) showed that among lesbian women jealousy was evoked more by a rival's physical attractiveness, and among gay men jealousy was evoked more by a rival's social dominance. Thus, these sex differences in the jealousy evoking nature of rival characteristics do not parallel characteristics that – given the mate preferences of their partners – actually constitute the largest threat.

Taken together, these studies make it evident that rival evaluation is not driven by the knowledge one has of one's partner's preferences, but, rather, it points to a deeply rooted sex-specific mechanism in rival evaluation. Moreover, it seems that these sex differences are primarily related to one's biological sex and are independent of one's sexual orientation (Buunk & Dijkstra, 2001). As suggested by Maner et al. (2003) and Maner, Gaillot, and DeWall (2007), contextual stimuli are able to trigger content-specific adaptive mechanisms that are relevant to human reproduction. In this thesis, I will argue that without one's conscious awareness of the presence of a rival, mere exposure to physically attractive rivals (in the case of women) or socially dominant rivals (in the case of men) will be sufficient to trigger jealous feelings.

Unconscious processes

Given the importance of rival evaluation for reproductive success – preventing rivals to interfere with one's relationship and threaten access to resources, or preventing them from threatening paternity confidence – it seems plausible that during the course of human

evolution, humans have evolved to be especially sensitive to the presence of rivals, especially those with desirable mating characteristics (see also Kenrick et al., 2007). Indeed, since this capacity is so fundamental, it is reasonable to assume that rivals may be detected outside conscious awareness – and subsequently influence jealousy responses. The focus of the present thesis is to determine whether men and women are able to detect a rival's characteristics without being consciously aware of having been exposed to him or her. So far, all studies on rival evaluation and jealousy have been pencil and paper studies and laboratory experiments with explicit presentations of rivals (e.g. Dijkstra & Buunk, 1998, 2002). Unfortunately, in these studies there is always the possibility of demand characteristics. That is, participants could have had theories about the research hypotheses and could have responded accordingly. To circumvent this, and to investigate unconscious processes in rival evaluation, in the studies described in this thesis I exposed participants to rival characteristics without their knowledge of being exposed to them. I used a technique that is often used in social cognition research, i.e., subliminal priming (Bargh, 1989). To my knowledge, the use of subliminal priming in jealousy research is new.

There is a large body of research that shows that it is possible to prime people with stimuli they report not having seen, but which nonetheless may influence their performance on subsequent tasks, their judgments, or their emotions (for an overview see Merikle, 2007). Bargh and Pietromonaco (1982) were the first to use this paradigm in a study on person perception. In their study, participants were exposed for 100 ms to words relating to hostility. Immediately after the word was flashed it was masked by a string of Xs. Next, participants were asked to read the description of a man named Donald behaving in a rather hostile way – his behavior could either be interpreted as stemming from the situation, or as stemming from his personality. Participants were asked to evaluate this behavior. The results showed that participants who had previously been primed with hostility words evaluated Donald's personality more negatively than participants who had not been exposed to hostility words. These last participants were more inclined to ascribe Donald's ambiguous behavior to situational factors (Bargh & Pietromonaco, 1982). Thus, without their awareness or control, these participants' evaluation Donald was influenced by the subliminal priming. After this first study, a number of studies on automatic evaluations and category accessibility has repeatedly established that unobtrusively presenting

participants with input cues may nonconsciously prime attitudes and emotions, and may influence participants' person judgments or object evaluations (e.g., Ferguson, Bargh, & Nayak, 2005; Dijksterhuis, 2004; Wegner & Bargh, 1998; Devine, 1989; Fazio, Sanbonmatsu, Powell, & Kardes, 1986).

These studies make the case that evaluating an object or a person as 'good' or 'bad' is activated immediately upon the mere perception of (parts of) that object or person. Another line of research in social cognition suggests that people not only evaluate persons that are presented to them subliminally, but also make social comparisons with these targets. These comparisons in turn affect self-evaluations in either a positive or negative way. Investigating the possibility of subliminal social comparisons, Stapel & Blanton (2004) exposed their participants to photographs of well-known people for 110 ms (Study 2c). In the intelligent target condition, participants were exposed to a photograph of Albert Einstein and in the unintelligent target condition to a photograph of a clown. After the subliminal priming, participants were asked to rate their own intelligence. The results showed a contrast effect of the primes on participants' self-evaluation: participants who were primed with the clown condition rated their intelligence significantly higher than participants who were exposed to Albert Einstein. Additional evidence for social comparison with targets one isn't aware of having seen takes place comes from a study by Mussweiler, Rüter, and Epstude (2004). In this study, participants were exposed to the names of well-known people (as opposed to photographs) and subsequently asked to evaluate their own athletic ability (Study 2). The results again show a contrast effect; when participants were exposed to the name of Pope John Paul – a target low in athletic ability – they rated themselves as significantly more athletic than when they were exposed to the name of professional football player Michael Jordan.

Social stimuli relevant to mating and mate-guarding may also be processed selectively and at a very early stage. In several experiments Maner, Gaillot, and DeWall (2007) showed that when a mating motive had been induced, both male and female participants' attention 'stuck' to physically attractive women, but not to attractive men. This bias for attractiveness was more pronounced in sexually unrestricted men and in women who were insecure about their current relationship. Supposedly, this last group is inherently more attuned to rivals. Moreover, in a second series of experiments, Maner, Gaillot,

Rouby, et al. (2007) showed that inducing a mate-guarding motive by having participants read a jealousy evoking scenario caused participants to be more attuned to attractive members of their own sex. This was especially true for men and women who were inherently more vigilant about intrasexual competitors. More evidence for an early order, attention-grabbing component in jealousy comes from a study by Schützwohl (2008), in which participants who were currently involved in a romantic relationship – and therefore hypothesized to be more vigilant to intrasexual competitors – had more difficulties disengaging their attention from cues signaling infidelity. These men and women recalled significantly less task-irrelevant target cues when they had been primed with cues relating to respectively sexual and emotional infidelity than men and women not currently in a romantic relationship (Schützwohl, 2008). In all of the studies described here, participants were unaware of the purpose of the study, or of the influence of the primes on their performance on subsequent tasks. As Schützwohl (2008) remarks, this "[...]points to the possibility that the jealousy mechanism in humans is a highly vigilant monitoring device that operates at very early and possibly involuntary stages of information processing" (p 642).

Applying these findings from research in both social cognition and evolutionary psychology to rival evaluation in a jealousy context, in the present thesis I assume that subliminal exposure to rival characteristics should suffice to activate feelings of jealousy. I propose that this will take place through the process of social comparisons between oneself and the rival, which will be made literally in the blink of an eye. The degree of jealousy is hypothesized to be based on the outcome of this comparison. Based on research on rival characteristics (e.g. Dijkstra & Buunk, 1998, 2002) I hypothesize that women will react with more jealousy after exposure to a physically attractive rival, and men after exposure to a socially dominant rival. Moreover, I investigate several possible moderating factors on the relationship between exposure to rivals and subsequent jealousy.

Thesis outline

In Chapter 2, I present two studies using subliminal priming with words relating to rival characteristics. Based on previous research on sex differences in the jealousy-evoking effect of rival characteristics (Dijkstra & Buunk, 2002) in these studies several words relating to physical attractiveness (such as 'sexy' and 'attractive') and several words relating to social

dominance (such as 'tough' and 'success') were chosen. After the subliminal priming, participants read a jealousy inducing scenario and their jealousy was assessed. I expected that the effect of the priming with the rival characteristics on jealousy would be moderated by several sex-specific variables. More specifically, it was hypothesized that for women, their self-reported mate value would act as a moderator on the effect the rival characteristics would have on jealousy. For men, it was expected that their satisfaction with their current relationship would act as a moderator. In Chapter 3 I describe a study in which again subliminal priming with words was used, but this time to induce the context in which the rival was assessed. I have primed men with either sex-related or commitment-related words and subsequently introduced a rival. Participants indicated how upset they would be if this rival would outperform them, thereby stressing the intrasexual competition situation. I describe how male sex drive relates to male intrasexual competition, and why I think it is a fundamental correlate of individual differences in mating strategies. Chapter 4 focuses on the physical attractiveness of one's rivals. More specifically, I reason that a low waist-to-hip ratio in women would be a characteristic that signals health and fertility, whereas a high shoulder-to-hip ratio in men would be a signal of physical dominance and strength. I describe two studies using Singh's (1993) line-drawings of figures with varying waist-to-hip (WHR) and shoulder-to-hip (SHR) ratios as subliminal primes. In this chapter, a slightly different subliminal priming paradigm is described, e.g. parafoveal subliminal priming. I predict that men being subliminally exposed to a line drawing of a figure with an attractive SHR will report more jealousy than men who are exposed to a line drawing of a figure with an unattractive SHR. Women are predicted to respond with more jealousy after subliminal exposure to a figure with an attractive WHR than after exposure to a figure with an unattractive WHR. Chapter 5 specifically focuses on female jealousy and the importance of facial attractiveness in female intrasexual competition. Again, a parafoveal subliminal priming paradigm was used, but this time I chose photographs of unattractive and attractive faces. The same paradigm was applied in Chapter 6, but in this chapter the focus is on male jealousy. I examine the influence of a rival's status on male jealousy and describe the influence of individual differences in possessive jealousy – also known as mate guarding – on the relationship between rival evaluation and jealousy. Finally, Chapter 7 contains a summary and an overall discussion of the empirical chapters of this dissertation.

Chapter 2

Jealousy in the blink of an eye

Jealous responses after subliminal priming with rival characteristics [1]

[1] This chapter is based on Massar, Buunk, & Dechesne (2008).

Romantic jealousy is one of the most pervasive and recognizable human emotions. And although it has a negative connotation in modern society, it can be regarded as an adaptive emotion that helps protect the pair bond. Evolutionary psychologists assume that human cognitive and motivational functioning is directed by specific functional mental mechanisms which have evolved to solve specific adaptive problems that were crucial in human evolutionary history. Given the importance of pair bonding to human reproductive success, it seems plausible that both the ability to assess a possible threat to one's relationship, as well as the subsequent appropriate emotional and behavioral responses to protect it, have evolved during the course of human evolution. In the present chapter, we focus on this response – jealousy – and propose that assessing the threat of a rival is so basic and important that it may occur outside of awareness, whereby rivals are assessed literally in the blink of an eye. To investigate this, a subliminal priming paradigm often used in social cognition research was adapted for the present purpose.

Jealousy and rival characteristics

Jealousy is regarded by evolutionary psychologists as a basic, adaptive mechanism to protect one's relationship and to prevent a partner's infidelity (Buss, 1994). It arises when threats to the relationship are observed in the form of the presence of real or imagined rivals. Jealousy thus functions as a signal emotion, alerting the individual that action has to be taken to protect the relationship. When confronted with a rival, people will try to assess the threat this rival poses to their relationship. This will be done in particular by making comparisons between the self and the rival on dimensions that contribute to a rival's attractiveness as a partner (Broemer & Diehl, 2004; DeSteno & Salovey, 1996; Dijkstra & Buunk, 1998, 2002; Gilbert et al., 1995).

Evolutionary psychologists assume that men and women should be most distressed about rivals who exceed them on dimensions relating to their mate value. Women seem to have an evolved preference for men who are able to provide them and their offspring with sufficient resources and protection. Therefore, a man's mate value is determined for a large part by characteristics that signal his ability to acquire social status and resources, such as assertiveness and self-confidence (e.g., Buss, 1989, 1994; Fletcher et al., 2004; Kenrick et al., 1990; Schmitt, 2005). On the other hand, men seem to have an evolved preference for

physically attractive women because in ancestral times attractiveness would have been a cue to a woman's health and fertility. Therefore, a woman's mate value is determined relatively more by the attractiveness of her face and body (e.g., Buss, 1989, 1994; Fletcher et al., 2004; Kenrick et al., 1990; Schmitt, 2005; Townsend & Levy, 1990b).

Thus, when confronted with a rival, women should be most jealous when this rival is physically attractive, and men should be most jealous when the rival possesses status-related characteristics such as social dominance. Indeed, research has repeatedly established that precisely these sex differences in the rival characteristics that evoke jealousy do occur (Dijkstra & Buunk, 1998; Yarab & Allgeier, 1999), and that these occur in different cultures (Buss et al., 2000), among heterosexuals as well as homosexuals (Buunk & Dijkstra, 2001; Dijkstra & Buunk, 2002), though in particular in response to emotional infidelity (Buunk & Dijkstra, 2004).

Automatic evaluation of rivals?

Being able to identify a rival, and thus a threat to one's relationship, is ultimately of importance to reproductive success. According to parental investment theory (Trivers, 1972), women are at risk of losing access to resources and protection when a rival interferes with their relationship. Men, on the other hand, risk paternity uncertainty, and thus the risk of investing their resources in a child that is not genetically theirs. Because rival evaluation is so important to reproduction, it can be assumed that during the course of human evolution, sensitivity to rival characteristics has evolved into such a basic mechanism that these characteristics may be perceived even outside conscious awareness, e.g. that rivals may be evaluated in the blink of an eye.

Thus far, research on jealousy and rival characteristics has presented participants either with explicit descriptions of rivals or with photographs of rivals, after which their jealousy was measured (e.g. Dijkstra & Buunk, 1998, 2002). In the present study, we applied a subliminal priming paradigm to investigate whether presenting rivals outside conscious awareness would also induce jealousy in participants. While to our knowledge the use of subliminal priming in jealousy research is new, numerous studies in social cognition suggest indeed that people may evaluate objects or persons as 'good' or 'bad' without even being consciously aware of their presence. Indeed, research on automatic

evaluations and category accessibility has repeatedly established that unobtrusively presenting participants with input cues can nonconsciously prime attitudes and influence participants' person judgments, object evaluations, or self-evaluations (e.g., Devine, 1989; Dijksterhuis, 2004; Fazio et al., 1986; Ferguson et al., 2005). Some research using this paradigm has already been applied to evolutionary psychology. For example, Roney (2003) established that certain visual input cues, i.e. attractive young women, primed a mate attraction orientation in men. In two experiments, men exposed to young women reported more favorable attitudes to material wealth, reported greater feelings of ambition and aggressiveness and described themselves as more extraverted than men exposed to other men or men exposed to older women. These effects were found without men's awareness of the influence of the experimental manipulation. In addition, recent studies on subliminal social comparisons suggest that people not only evaluate persons that are presented to them subliminally, but also make social comparisons with these targets. Targets presented subliminally either in the form of photographs of well-known people (e.g. Einstein, see Stapel & Blanton, 2004), or in the form of names of well-known people (e.g. Michael Jordan, see Mussweiler et al., 2004), appeared to induce changes in participants' self-evaluations.

Applying such findings to rival evaluation in a jealousy context, we assume that subliminal exposure to a rival should suffice to activate feelings of jealousy, with women reacting with more jealousy after exposure to a physically attractive rival than after exposure to a socially dominant rival, whereas men will respond with more jealousy after exposure to a socially dominant rival than after exposure to a physically attractive rival.

The role of women's self-reported mate value

Jealousy in response to implicitly presented rival characteristics will in part depend on one's *own* mate value, and we want to suggest that this is particularly true for women. There are several lines of research in support of this prediction. Women's jealousy seems more than men's jealousy to be related to comparing oneself with the rival (Dijkstra & Buunk, 2001); women's preferences for a long-term mate are more than men's preferences dependent on their self-evaluations as long-term mates (Buston & Emlen, 2003; Sprecher & Regan, 2002), and women, to a greater degree than men, consider the mate preferences of their romantic

partners in assessing the threat imposed by rivals (DeSteno & Salovey, 1996). These findings suggest that women 'keep track' of their own mate value and their partner's mate preferences and use this information in gauging the threat of romantic rivals. Indeed, in a study by Gutierres, Kenrick, & Partch (1999) women who were exposed to a physically attractive rival had significantly lower self-ratings of their desirability as a marriage partner than women exposed to socially dominant rivals.

Thus, women's responses to rivals may be more affected by their own mate value than men's responses. We therefore expected that women who feel they have a low mate value, and whose self-perceived chances of finding a new mate thus are slim, are overall more sensitive to the presence of *any* rival. On the other hand, women with a high mate value will only become jealous when confronted with a rival that constitutes a real threat and will thus respond with more jealousy to a physically attractive than to a socially dominant rival. Thus an interaction between rival characteristics and mate value was expected. Women with a low mate value will report more overall jealousy, but women with a high mate value report more jealousy in response to implicitly presented physically attractive than to socially dominant rivals. Similar effects were not, or to a weaker extent, expected for men.

The role of men's relationship satisfaction

There is reason to assume that for men, more than for women, relationship satisfaction may have an influence on their feelings of jealousy. A man who enters a relationship faces the adaptive problem of being at risk for cuckoldry by his partner and, consequently, the problem of paternity uncertainty. In general, paternal investment depends more heavily on relationship satisfaction than maternal investment (Geary, 2005): for men more than for women, investing in a relationship means reducing the potential reproductive benefits from short-term mating. Relationship satisfaction can be regarded as an indicator of the investments in the relationship one has already made and will continue to make in the future, as well as an indicator of one's mate's investment intentions. Previous research has established substantial correlations between relationship satisfaction and relationship investments ($r = .41$, $p < .01$), showing that the more satisfied participants were, the more they invested in their relationship (Buunk & Bakker, 1997). When a man is highly satisfied

with his relationship and has invested heavily in it, the 'costs' would be substantial if his mate commits an act of infidelity, and we therefore expect men who are satisfied with their current relationship to be more jealous than men who are dissatisfied. Particularly relevant for our present argument, several studies have shown that for men, having been or being in a committed relationship predicts upset over a partner's infidelity and jealousy more than for women (Buss et al., 1992; Murphy, Vallacher, Shackelford, Bjorklund & Yunger, 2006). Thus, one can hypothesize that individuals who are highly satisfied with their relationship may be particularly upset when their partner shows signs of low commitment. In sum, we expect that men high in relationship satisfaction will report more overall jealousy about the presence of rival than men low in relationship satisfaction, but especially when this rival has a similar mating strategy – e.g. a socially dominant rival with resources or with the potential to acquire those resources later in life.

Overview of studies in the present chapter

To summarize, the present chapter examined if rival evaluation may be an unconscious process, engaged in automatically whenever a rival is encountered. To investigate this, three studies were performed that are described in the present chapter.

The first study had two purposes. First of all, we sought to replicate the findings by Dijkstra and Buunk (2002). As was mentioned above, these authors found that women indicated they would feel more jealous when their romantic rival possessed characteristics indicative of physical attractiveness, whereas men reported more jealousy when imaging their rival as having a high status and being socially dominant. We expect this pattern of results for the present study as well. The second aim of the first study was to pretest the words which would be used as subliminal primes in our second experiment.

In this second study, words relating to rival characteristics were subliminally presented to participants, after which they read a jealousy evoking scenario describing someone flirting with their partner. Next, their jealousy was assessed. It was expected that women, particularly when in high in mate value, would report more jealousy after exposure to words relating to physical attractiveness than after exposure to social dominance words, although those low in mate value would report more overall jealousy. It was expected that

men high in relationship satisfaction would report more jealousy overall, but especially after exposure to words relating to social dominance.

Finally, in Study 2.3, we look at women's menstrual cycle as a possible moderator of the relationship between rival characteristics and jealousy.

Study 2.1

Method

Participants

Eighty-five men and eighty-five women of the University of Groningen took part in this online-study. The study was part of a large database of online studies all first-year psychology students were required to complete for course credit. On the basis of their sex, participants were assigned to either the male version or the female version of the study.

Materials and procedure

After logging in to the website on which the online-questionnaires were administered, participants were assigned to either the male or the female version of the study. Next, they read a jealousy-inducing scenario and indicated which rival characteristics they found most distressing.

The jealousy-inducing scenario which the participants in the present study read was taken from a study by Dijkstra and Buunk (1998). Participants were told to imagine they were going to a party with their boyfriend or girlfriend. At this party, they observed their partner talking to a stranger of the opposite sex, who seemed to be flirting with their partner. The participants were told to imagine their partner seemed to enjoy this attention and was very interested in this stranger. As the night progressed, they seemed absorbed in each other.

After reading this scenario, participants indicated on a seven-point Likert-type scale (1 = *not upset at all*, 7 = *very upset*) how jealous they would be if the situation described in the scenario would happen to them, and they were asked to indicate on a seven-point Likert-type scale (1 = *not upset at all*, 7 = *very upset*) how well they were able to imagine the

scenario happening to them. Next, for exploratory reasons, we included two forced-choice dilemmas in the study (adapted from Buss et al., 1992). The first dilemma asked what they thought would happen next in the scenario, the second asked what they would find more upsetting. For both dilemmas participants could choose between:

1. Their partner would have sex with this other person
2. Their partner would fall in love with this other person.

Finally, participants were asked to indicate on a seven-point Likert-type scale (1 = *not upset at all*, 7 = *very upset*) how upset they would be about certain characteristics their rival – that is, the stranger in the scenario – possessed. Participants indicated how distressed they would be if the stranger flirting with their partner...: was sexy, was tough, was slender, had a lot of money, had success, was attractive, had power, or was beautiful. Note that these are imperfect translations of Dutch adjectives that apply equally to men and women. For example, in Dutch, the word 'knap' means both 'handsome' and 'pretty'.

Results

Participants indicated they would be quite jealous when the situation described in the scenario would happen to them (overall **M** = 5.49). Although women indicated they would be slightly more jealous than men, **M** = 5.65 and **M** = 5.33 respectively, this difference was not significant ($F(1,168) = 2.43$, *ns*). The scenario proved to be effective: participants were quite able to imagine the situation happening to them (**M** = 5.58), and again, there was no sex difference: $F(1,168) = 1,18$, *ns*; $\mathbf{M}_{men} = 5.47$, $\mathbf{M}_{women} = 5.68$.

The forced-choice dilemmas were analyzed for each sex separately, using Chi-Square tests. These showed that women thought it more likely their partner would fall in love with their rival after reading the scenario (62,2%) than that he would have sex with the rival (37,8%, $\chi^2(1; N = 225) = 13.44$, $p < .001$). The male results showed the same pattern: 72,9% of participants thought their partner would fall in love with the rival, whereas 27,1% thought she would have sex with the rival ($\chi^2(1; N = 85) = 17,89$, $p < .001$). When asked what they would find more upsetting, 81,3% of women answered that they would be more

upset by their partner falling in love with the rival, and only 18,7% answered they would find it more upsetting if their partner would have sex with the rival (χ^2 (1; N = 225) = 88,36, p <.001). Surprisingly, an equal number of men indicated that they would find their partner falling in love upsetting (58,8%) as the number of men that indicated that their partner having sex with the rival would upset them most (41,2%; χ^2 (1; N = 85) = 2,65, *ns*). This pattern of results remained when we only included participants who at the time of the experiment were in a relationship (46,9% indicate their partner having sex as more upsetting; 53,1% indicated their partner falling in love as more upsetting (χ^2 (1; N = 32) = .13, *ns*).

Since we predicted that women would be most upset over a physically attractive rival and men over a socially dominant rival, a Principal Component Factor Analysis with Varimax Rotation was performed on the rival characteristics. As predicted, two factors were extracted. The first factor consisted of the characteristics *sexy*, *pretty, beautiful*, and *slender* (α = .85, factor loadings > .62) and was named Attractiveness. The second factor consisted of the characteristics *tough*, *money*, *success*, and *power* (α = .76, factor loadings > .52) and was named Social Dominance. Since reliability of these factors was good, we decided to compute a mean score for Attractiveness (M = 4.95) and Social Dominance (M = 3.89).

Next, t-tests were performed with participant sex as the predictor and Attractiveness (factor 1) and Social Dominance (factor 2) as the dependent variables. These analyses showed that women were more upset by the attractive rival than men: t (168) = -5.62, p < .001 (M = 5.46 and M = 4.44 respectively). In contrast, men were more upset by the socially dominant rival than women: t (168) = 2.83, p < .01 (M = 4.15 and M = 3.64 respectively).

Discussion

We found clear evidence for a sex-specific rival evaluation mechanism: men reported being more upset when their rival possessed characteristics relating to social dominance, whereas women reported being more upset when their rival was physically attractive. These effects were similar to the results reported by Dijkstra and Buunk (2002). We did not find any sex differences in the overall amount of jealousy the scenario evoked in participants, suggesting

that it was the rival, and not the jealousy-evoking situation itself that proved upsetting. Together, these findings suggest that males and females possess an evolved mechanism through which they respond to those rival characteristics that have been important in intrasexual competition in our evolutionary past.

We included two forced-choice dilemmas in the study (adapted from Buss et al., 1992). When asking about which event would be most likely in the situation described in the scenario, both men and women unanimously answered that they thought it most likely their partner would fall in love with the rival. This would also be more upsetting to women than their partner having sex with the rival (dilemma 2), which is in line with the results reported by Buss et al. (1992). However, men indicated they would find both the thought of their partner falling in love and of her having sex with the rival equally upsetting, although the percentage of men indicating upset over sexual infidelity is higher than the percentage of women indicating upset over sexual infidelity (41,2% versus 18,7%). This is in line with what Buss et al. (1992) reported, who found that men found a sexual infidelity of their partner more upsetting than women. However, these authors also report that men choose the sexual infidelity as more upsetting than the emotional infidelity, which contrasts with our findings (Buss et al., 1992). If nothing else, the current result suggests that the scenario we have used makes the threat of a partner falling in love with another person more salient than the thought of the partner having sex.

Study 2.2

Because the words used in Study 2.1 evoked the hypothesized sex-specific responses in participants, we decided to include them in our next study. In this second study we used subliminal priming to present the rival characteristics to participants. By using subliminal priming one can circumvent possible demand characteristics in participants, since they are not aware of the manipulations. Moreover, as we have detailed above, since rival evaluation is so important to reproductive success there is reason to assume that over the course of human evolution, it has evolved in such a way that rival characteristics may be perceived even outside of conscious awareness.

Method

Participants and design

Seventy-five heterosexual students (35 men and 40 women, Mean Age = 22.8, SD = 1.94) of the University of Groningen took part on a voluntary basis, and were paid for their participation. Men and women were randomly assigned to either the social dominance condition or the attractiveness condition.

Materials

To measure participants' mate value, the Dutch translation of the Self-Perceived Mating Success Scale (Landolt, Lalumière, & Quinsey, 1995) was used. Participants could indicate on a five-point scale (1 = *not at all*, 5 = *very much*) how applicable certain statements about their 'market value' were to them. Examples are: 'I receive many compliments from members of the opposite sex'; 'I receive invitations for sex from members of the opposite sex '. Coefficient alpha = .75, M = 3.31, SD = .52.

Nineteen men and 25 women who were in a relationship at the time of the experiment completed the Relationship Interaction Satisfaction Scale (Buunk, 1990). The scale measures the frequency with which the interaction with the partner in an intimate relationship is experienced as rewarding and not as aversive. There are eight items in this scale, and examples are: 'I feel happy when I'm with my partner', and 'We have quarrels' (reverse score). On a five-point scale (1 = *never*, 5 = *very often*) participants could indicate how often these statements applied to them. Coefficient alpha = .81, M = 4.16, SD = .49.

The rival characteristics used in the subliminal priming procedure were taken from research by Dijkstra and Buunk (2002, Studies 1 & 2) in which men and women were asked to generate words relating to attractiveness and social dominance. For the present experiment, the characteristics that were mentioned most often by these participants were chosen. For the attractiveness condition, these were *'attractive', 'beautiful', 'slender'*, and '*sexy*'. For the social dominance condition, *'tough', 'money', 'power'*, and '*success'* were used. Please note that in Dutch, these words are applicable to both sexes.

Jealousy was measured using a jealousy sliding scale on the computer, with endpoints 0 (*not jealous at all*) and 100 (*extremely jealous*). Participants could use the

mouse to slide a knob to the position on the scale that best indicated their feelings. To our knowledge, the use of this slider is new to research on jealousy. Since jealousy is still considered an 'unwanted' emotion, participants are often inclined to give answers that are socially desirable. By using a continuous scale and providing them with only two end-points, participants are no longer forced to make a choice, but can instead answer the question more intuitively.

To control for the possibility that the subliminal primes influenced participants' self-evaluations, after they indicated their jealousy we asked participants how inferior they would feel in a situation like the one described in the scenario. Endpoints were 1 (*not inferior at all*) and 5 (*very inferior*); M = 2.08, SD = 1.16.

Procedure

Participants were told they were participating in research on emotions in intimate relationships and were seated behind a computer on which all instructions and questionnaires were administered. They first completed the Mate value questionnaire and – if in a relationship – the Relationship Interaction Satisfaction Scale. Next, in a subliminal priming procedure adapted from Dijksterhuis (2004), they were told they were going to make an 'association task'. Participants' task was to indicate as quickly as possible if two neutral words presented on the screen were related to each other by pressing one of two colored keys on the keyboard. However, scores on this task were not recorded, since its only purpose was to prime participants either with an attractive or a socially dominant rival.

The visible 'association' words in the task had no relation to rival characteristics, but were neutral words like '*house*' and '*garden*'. During this task, and in between the two neutral words, participants were subliminally exposed to the rival characteristics. Each rival characteristic word was preceded by a personal pronoun, 'he' for the men and 'she' for the women, and both primes were presented for 17 ms each. The pronouns were included to ensure that participants would not relate the rival characteristics to themselves, but would project them onto a person described in the scenario presented to them after the association task.

There were four rival characteristics for each condition, and each word was presented five times, making a total of 20 trials. A trial would consist of a neutral word

(presented for 1.5 sec), a personal pronoun (17 ms), a rival characteristic (17 ms) and then another neutral word (1.5 sec).

After completing the association task, participants read a shortened version of the scenario developed by Dijkstra and Buunk (1998). Participants were told to visualize the situation described in the vignette before continuing with the experiment. An example of the male version:

You are at a party with your girlfriend and you see an unfamiliar man walk up to her. He starts flirting with her. She seems to like it, and starts flirting back.

The next part of the experiment consisted of the jealousy slider, on which participants could indicate how jealous they would feel if the situation described in the scenario would happen to them. Next, they indicated how inferior they would feel in this situation. Finally, using a funneled debriefing method (Bargh, Chen, & Burrows, 1996), participants' awareness of the subliminal primes was assessed. Participants indicated they had only seen the two neutral words on the screen and were not aware of the subliminal priming.

Results

Self-evaluation

First of all, we analyzed the item 'inferior' to check whether the subliminal primes had influenced participants' self-evaluations, which in turn could be responsible for differences in jealousy scores. However, an ANOVA with participant sex and rival characteristics as predictors and inferior as the dependent variable only showed a main effect for participant sex: $F(1,72) = 5.82$, $p < .05$, $\eta^2 = .08$. Women reported feeling more inferior in the jealousy evoking situation than men: M = 2.39 and M = 1.75 respectively. There was no significant main effect of the priming with rival characteristics: F (1,72) = .07, *ns*, or a significant interaction between participant sex and rival characteristics (F (1,72) = .22, *ns*). We therefore concluded that participants' self-evaluations were not affected by the subliminal priming.

Mate value

A regression analysis with participant sex (male vs. female), rival characteristic (attractiveness vs. social dominance) and mate value (standardized) as predictors, and jealousy as the dependent variable was conducted. All two-way and three-way interactions were included in the analysis (N = 75). The overall model was significant: $R^2 = .21$, $F(7,68) = 2.51$, $p < .05$.

There were no main effects of participant sex or rival characteristics (*B*s < 3.42, *t*s < 1.20, *ns*). As predicted, there was a marginally significant main effect of mate value, $B = -5.39$, $t(68) = -1.83$, $p = .07$, that was qualified by a marginally significant interaction between participant sex and rival characteristics: $B = 5.21$, $t(68) = 1.80$, $p = .08$. The other two-way interactions were not significant (*B*s < -1.23, *t*s < -.42, *ns*). However, the three-way interaction between participant sex, rival characteristics and mate value was significant: $B = 7.23$, $t(68) = 2.46$, $p < .05$. For an overview of the results of this analysis, see Table 1.

To interpret the three-way interaction, simple effect analyses were performed. These showed that women with low mate value (-1 SD) reported equal – high – levels of jealousy in response in both the attractiveness and the social dominance condition: $M = 78.51$ and $M = 75.15$ respectively ($B = 1.68$, $t(68) = .28$, *ns*). On the other hand, women with high mate value (+1 SD) *did* differentiate between the rival characteristics: they reported significantly more jealousy after being primed with attractiveness words ($M = 82.03$) than after being primed with social dominance words ($M = 48.51$): $B = 16.76$, $t(68) = 3.25$, $p < .01$. These results thus support the expectation that women would react with more jealousy after being primed with an attractive rival, but as predicted, only for women with *high* mate value. For an illustration of these results, see Figure 1.

For men, the simple effects analyses revealed no significant main effects. Men low in mate value (-1 SD) reported equal amounts of jealousy after being primed with social dominance words (M = 61.96) as after being primed with attractiveness words (M = 73.40): $B = 5.72$, $t(68) = 1.01$, *ns,* and the same was true for men high in mate value (+1 SD), respectively M = 65.83 and M = 49.57 ($B = -8.13$, $t(68) = -1.25$, *ns*). For an illustration, see Figure 2.

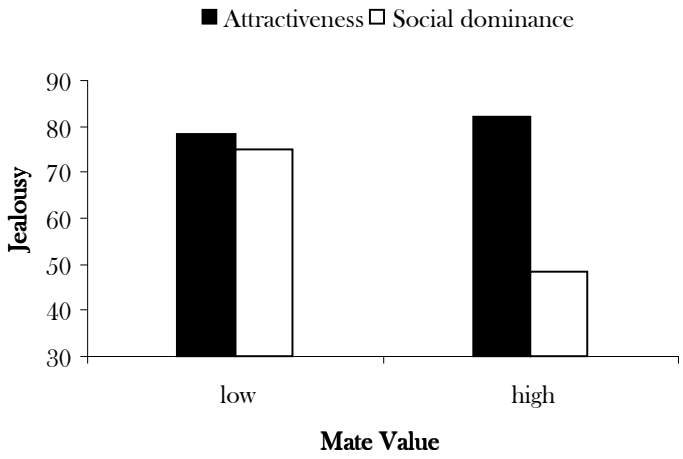

Figure 1. Jealousy scores for women low and high in mate value after subliminal exposure to either attractiveness words or social dominance words.

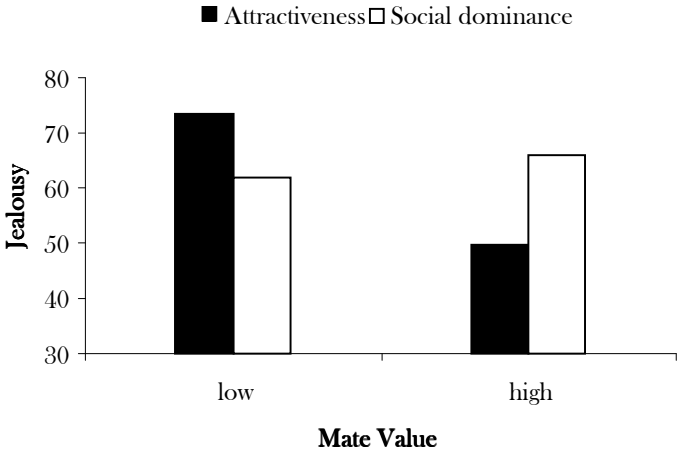

Figure 2. Jealousy scores for men low and high in relationship satisfaction after subliminal exposure to either attractiveness words or social dominance words.

Table 1. Results of Hierarchical Regression Analysis using Mate Value as a moderator (N = 75)

Variable	*B*	*SE B*	*t*	*p*
Participant Sex (PS)	4.18	2.90	1.44	.15
Rival Characteristic (RC)	4.01	2.90	1.38	.17
Mate Value (MV)	-5.39	2.94	-1.83	.07
PS X RC	5.21	2.90	1.80	.08
PS X MV	-.40	2.94	-.13	.89
RC X MV	.31	2.94	.11	.92
PS X RC X MV	7.23	2.94	2.46	.02

Note. Jealousy was measured using a slider ranging from 0 (*not jealous at all*) to 100 (*extremely jealous*). $R^2 = .21$, $F(7,68) = 2.51$, $p < .05$.

Relationship Satisfaction

A hierarchical regression analysis with participant sex (male/female), rival characteristic (attractiveness/social dominance) and relationship satisfaction (standardized) as predictors, and jealousy as dependent variable was conducted. All two-way and three-way interactions were included in the analysis (N = 45). The overall model was significant: $R^2 = .46$, $F(7, 36) = 4.33$, $p < .01$.

There were no main effects of participant sex or rival characteristic (Bs < 5.83, ts < 1.78, *ns*). There was a significant main effect of relationship satisfaction, $B = 8.29$, $t(36) = 2.42$, $p < .05$, that was qualified by a significant interaction between participant sex and relationship satisfaction: $B = -10.16$, $t(36) = -2.97$, $p < .01$. The other two-way interactions were not significant (Bs < 3.90, ts < 1.19, *ns*). The three-way interaction between participant sex, rival characteristic and relationship satisfaction was marginally significant ($B = 5.67$, $t(36) = 1.66$, $p = .11$). For an overview of all results from this analysis, see Table 2.

To interpret the interaction, simple effect analyses were performed. These showed that women high (+1 SD) and low (-1 SD) in relationship satisfaction did not differ in their jealousy response after priming with attractiveness words, $B = .08$, $t(36) = .01$, *ns* (M = 84.57 and M = 84.40 respectively) and neither after priming with social dominance words: B = -3.82, $t(36) = -.58$, *ns* (M = 68.82 and M = 61.19 respectively). See Figure 3 for an illustration of these effects.

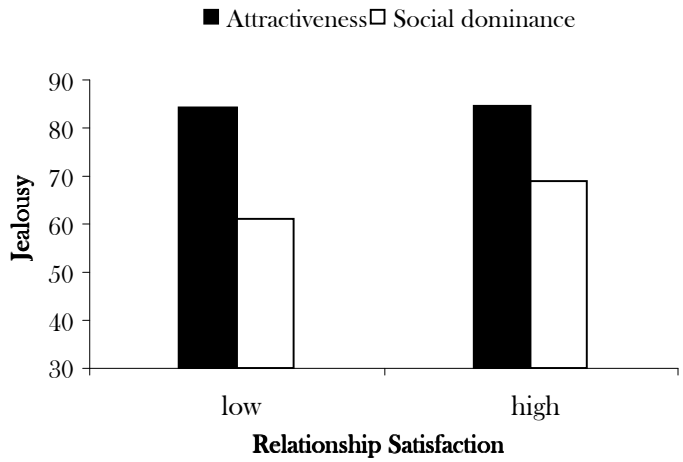

Figure 3. Jealousy scores for women low and high in relationship satisfaction after subliminal exposure to either attractiveness words or social dominance words.

As predicted, simple effect analyses for men showed that men high (+1 SD) in relationship satisfaction reported more jealousy after exposure to a socially dominant rival (M = 90.42) than men low (-1 SD) in relationship satisfaction (M = 34.75): B = 27.84, t (36) = 4.40, p < .001. However, men high and low in relationship satisfaction did not differ in their jealousy response after priming with attractiveness words: B = 9.07, t (36) = 1.10, *ns* (M = 75.51 and M = 57.38 respectively). For an illustration of these effects, see Figure 4. These results support the prediction that for men, their jealousy responses are moderated by the level of their relationship satisfaction. Men high in relationship satisfaction reported more jealousy than men low in relationship satisfaction, and especially after exposure to social dominance words.

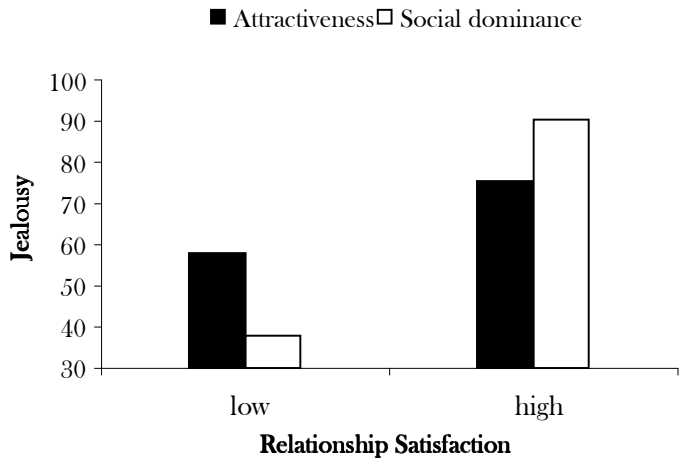

Figure 4. Jealousy scores for men low and high in relationship satisfaction after subliminal exposure to either attractiveness words or social dominance words.

Table 2. Results of Hierarchical Regression Analysis using Relationship Satisfaction as a moderator (N=45)

Variable	*B*	*SE B*	*t*	*p*
Participant Sex (PS)	5.12	3.28	1.56	.13
Rival Characteristic (RC)	5.84	3.28	1.78	.08
Relationship Satisfaction (RS)	8.29	3.42	2.42	.02
PS X RC	3.90	3.42	1.19	.24
PS X RS	-10.16	3.42	-2.97	.005
RC X RS	-3.72	3.42	-1.09	.28
PS X RC X RS	5.67	3.42	1.66	.11

Note. Jealousy was measured using a slider ranging from 0 (*not jealous at all*) to 100 (*extremely jealous*). $R^2 = .46$, $F(7,36) = 4.33$, $p < .01$.

Discussion

Over the course of human evolutionary history, men and women faced the adaptive problem of protecting the pair-bond from interlopers to enhance offspring survival. We argue that evaluation of these rivals has evolved into a process that occurs largely outside conscious awareness, and we assume that subliminal exposure to a rival should suffice to activate feelings of jealousy, with women reacting with more jealousy after exposure to a physically attractive rival, and men after exposure to a socially dominant rival. Results show that this is indeed the case, but that men and women's jealousy responses are moderated by different variables.

Mate value

The results from Study 2.2 showed that women with a low mate value responded with more jealousy to rivals than women with a high mate value, but that women with a high mate value differentiated between rivals and responded with more jealousy to a physically attractive than to a socially dominant rival. There were no moderating effects of mate value found for men. From an evolutionary point of view, it is adaptive for women to be aware of not only their own, but also other women's mate value. Therefore, women with a low mate value should react strongly to the presence of any rival, independent of her characteristics. After all, not only is their partner more likely to abandon them in favor of the more attractive rival, but should this actually happen, there is a risk women with a low mate value might not find a new mate. On the other hand, women with a high mate value can 'afford' to be more differentiated in their jealous responses. For them, it is more relevant to focus on those characteristics that make a rival a more desirable partner than they themselves are, e.g. physical attractiveness. A similar pattern of results was found by Dijkstra and Buunk (2005) in a study on the jealousy evoking effect of a rival's body build. In this study, women's own perceived body build moderated the relationship between a rival's body build and jealousy responses. Women who felt they had a low Waist Hip Ratio (WHR) – e.g. an attractive body shape – reported more jealousy after exposure to a rival who also had a low WHR, than women who felt they had a high WHR.

Relationship satisfaction

The results showed that men high in relationship satisfaction reported more jealousy after exposure to rival characteristics than men low in relationship satisfaction, but especially after exposure to a socially dominant rival, whereas men high and low in relationship satisfaction did not differ in their response to an attractive rival. No moderating effects of relationship satisfaction were found for women. These findings are in line with the idea of variance in mating strategies (Gangestad & Simpson, 2000; Fletcher et al., 2004), with some men focusing more on short-term mating and engaging in intrasexual competition, and other men focusing more on long-term mating and parental investment. For men, more than for women, engaging in a close relationship implies having to forsake alternative mating opportunities. Relationship satisfaction is an indicator of one's own investments in the relationship, as well as a partner's investment intentions (Buunk & Bakker, 1997). Satisfied men are likely to be higher in relationship investment and therefore could be said to prefer a long-term mating strategy over an intrasexual competition strategy. A recent study by Kruger and Fisher (2005) showed that not only women, but also men are aware of other men's reproductive strategies. The men in this study were very accurate in predicting traits and tendencies that are associated with parental investment (e.g. provide more resources, would make a better husband) or mating effort (e.g. would cheat on partner, would wear more flashy clothes). We argue that men who are confronted with a rival who displays a certain reproductive strategy, react with more jealousy when this strategy 'matches' their own strategy. In general, while socially dominant rivals – displaying long term investment traits and tendencies – evoke more jealousy than physically attractive rivals (Dijkstra & Buunk, 2002), the present research suggests this is especially true for men who have adopted a similar strategy, e.g. men high in relationship satisfaction. Like women track their own and other women's mate value to gauge a rival's threat to their relationship, it seems that men track their own and other men's reproductive strategies in assessing a rival's threat.

To sum up, this study established for the first time that it is possible to induce jealousy in participants through subliminal presentation of sex-specific rival characteristics. Our findings suggest that unconsciously linking certain features to a third person may lead

to 'projecting' these characteristics onto a rival that is described without any characteristics in a scenario.

Study 2.3

There are reasons to assume that besides her self-rated mate value, a woman's menstrual cycle also affects jealous feelings after exposure to rivals. One could argue that during the fertile period of a woman's cycle, the presence of a physically attractive rival might be an especially large threat to women. Indeed, research has established that when in the fertile (ovulatory) phase of their cycle, women report increased attraction to men other than their primary partners (Gangestad, Thornhill, & Garver, 2002) and they show a preference for men who display signs of social dominance and intrasexual competition tactics (Gangestad, Simpson, Cousins, Garver-Apgar, & Christensen, 2004). These studies show that women's mate preferences shift across the menstrual cycle. Gangestad and Simpson (2000) detail how women 'trade off' good genes characteristics for good provider characteristics when looking for mates. Dependent, among other things, on where they are in their reproductive cycle, they place emphasis on either good genes or good provider characteristics.

Moreover, not only do mate preferences shift, there are studies that indicate that fertile women are more sensitive to intrasexual competition as well. During the fertile phase of their cycle, women tend to be more prone to feelings of jealousy, especially when imagining their partner forming a deep emotional attachment to another woman (Krug, Finn, Pietrowsky, Fehm, & Born, 1996), and they are especially sensitive to cues of emotional infidelity of their partner (Gaulin, Silverman, Phillips, & Reiber, 1997). Men's behavior is also influenced by a woman's menstrual cycle. During the fertile phases of their partner's ovulatory cycle men tend to engage more in mate guarding behavior, i.e. they are more attentive to their partner and they act more proprietary (Gangestad et al., 2002).

Given the evidence for the influence of women's menstrual cycle on their mating behavior, in the next study we examined whether women's menstrual cycle influences the effect that subliminally presented rival characteristics have on jealousy. We expect that women who at the time of the experiment are in the fertile phase of their menstrual cycle

report more jealousy after exposure to rival characteristics – and especially after exposure to an attractive rival – than women who are not in the fertile phase of their cycle.

Method

Participants

Participants were female students (N = 104, mean age = 19.7, SD = 3.0) of the University of Groningen. They were randomly assigned to either the physical attractiveness or the social dominance condition.

Materials and procedure

The materials used in the present study were identical to those used in Study 2.2, with the exception of the words used in social dominance condition. We decided to operationalize social dominance in a different way. Instead of *money*, we used *rich,* and instead of *success*, we used *successful.* The other two words were also mentioned by participants in the Dijkstra & Buunk (2002) studies, and these were *popular* and *assertive*.

To test the possibility of a menstrual cycle effect, participants were divided into two groups based on their self-reported menstrual cycle status. Mixed in with some filler questions on age, health and doctor's visits, participants were asked to specify the date of the first day of their last menstruation. The date they completed the experiment was also known, so the number of days they were into their menstrual cycle could be calculated. We used Fisher's (2004) method of grouping the participants: cycle days of 12-21 days – with day 1 representing commencement of menses – indicated participants in the fertile phase of their cycle (N = 30), whereas days 1-11 and 22 and over indicated participants who were not in the fertile phase of their cycle (N = 59). Fifteen women were unable to report the date of their last menstruation and were left out of further analyses.

Once participants completed some general questions (age, study) and the filler questions on health, they were told they were going to make an association task (for details, see method Study 2.2). After this task, they read the jealousy-inducing scenario and indicated their jealousy on a slider. Finally, using a funneled debriefing method (Bargh et al., 1996), participants' awareness of the subliminal primes was assessed. As in Study 2.2,

participants indicated they had only seen the two neutral words on the screen and were not aware of the subliminal priming.

Results

An ANOVA analysis with menstrual cycle (high/low estrogen) and rival characteristics (physical attractiveness/social dominance) as the independent variables, and jealousy as measured by the slider as the dependent variable was conducted. No main effects of Menstrual Cycle or Rival Characteristics were found, but there was a significant interaction between these two variables: $F(3,85) = 3.89$, $p = .05$, $\eta^2 = .04$. As predicted, when exposed to attractiveness words, women who were in the ovulatory phase of their cycle at the time of the experiment reported more jealousy than women who were not in the ovulatory phase (M = 81.70 and M = 68.51 respectively). Women who were exposed to Social Dominance words did not differ in reported jealousy ($M_{high} = 71.87$ and $M_{low} = 74.77$; see figure 5).

Discussion

The results from this study, which employed the same paradigm as the Study 2.2, showed that women in the fertile phase of their cycle did indeed report more jealousy after exposure to a physically attractive rival than after exposure to a socially dominant rival than women who were not in the fertile phase of their cycle. This suggests that a woman's ovulatory cycle has a strong effect on the way women respond to subliminally presented rival characteristics. As mentioned before, we hypothesize that women possess an evolved tendency to respond with jealousy to intrasexual competitors, especially at times when the reproductive stakes are high.

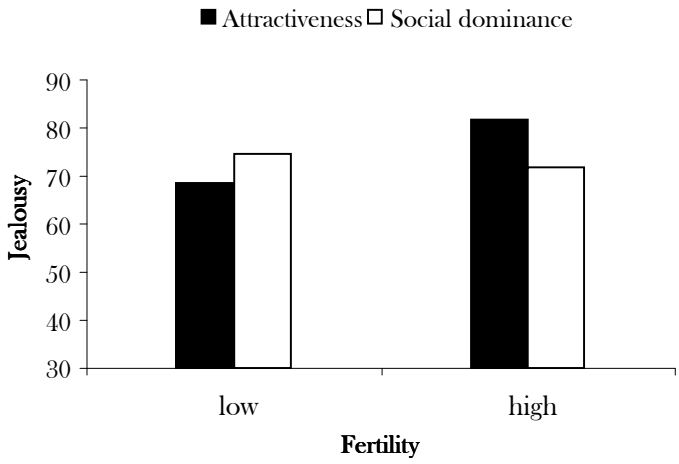

Figure 5. Jealousy scores for women low and high in fertility after subliminal exposure to either attractiveness words or social dominance words.

There is one limitation to the present study that needs to be addressed. Unfortunately, we did not ask our female participants about their use of hormone based forms of birth control. In all likelihood, most of the women in our study did indeed use a form of hormone based birth control. This could have had an influence on their jealousy scores, and, of course, it makes the use of the term 'fertile' inappropriate. However, as a study on jealousy and estrogens by Geary, DeSoto, Hoard, Sheldon, and Cooper (2001) showed, women who use hormone-based contraceptives report more intense affective feelings when confronted with an infidelity of their partner than women who were cycling naturally. Future studies need to determine what, if any, the effect of hormone based contraceptives is on the relationship between rival characteristics and jealousy.

Conclusion

Although some people like to believe that, despite their biological differences, men and women are essentially the same, according to evolutionary psychology men and women do not only have different bodies, they also have different minds. This is in particular due to the fact that, during their life, women produce only a limited amount of eggs, whereas men produce billions of sperms. This has lead men and women to make essentially different investments in their offspring, producing different adaptive problems for men and women (Buss, 1994; Miller, 2002). The findings from the present chapter seem to suggest that the evaluation of rivals in a romantic jealousy situation is a basic mechanism that may function unconsciously and automatically, and which is affected by factors that are relevant from an evolutionary perspective, such as mate value and fertility of the female.

However, although the results from the present chapter by and large support our hypotheses, there are several limitations that need to be acknowledged. First of all, control conditions were not included in the studies reported here. It is possible that comparisons between the experimental conditions and a control condition shed more light on the underlying processes. For example, even though we hypothesize participants subconsciously compare their own mate value with that of their rivals (see also Dijkstra & Buunk, 1998, 2002; Broemer & Diehl, 2004), which would lead to more jealousy for participants confronted with an attractive or socially dominant rival, from the present results one cannot definitively determine whether this was indeed the case. We suggest that in future studies, a control condition should be included to assess the exact nature of the relationship between the threat of a rival and subsequent jealousy when using a subliminal priming paradigm.

Secondly, we did not include measures of self-evaluation after the priming – with the exception of the item 'inferior'. It is possible that the priming with the rival characteristics had an effect on participants' self-esteem, mate value or relationship satisfaction – or, indeed, on all three. This, in turn, could have influenced their feelings of jealousy. Future research needs to address this issue by including relevant self-evaluations after the priming.

Finally, as mentioned before, the question whether hormone based contraceptives influence the relationship between subliminal exposure to rival characteristics and jealousy

needs to be addressed in future studies. Ideally, both naturally cycling women and women who use hormone based birth control should be invited to participate in an experiment and their scores should be compared. This would help to determine the exact nature of the threat a rival poses to a fertile woman, as well as the effect contraceptives have on this process. Furthermore, it would be interesting to perform a within-participants experiment using naturally cycling women, to determine whether the menstrual cycle causes shifts in the evaluation of rivals as well as in mate preferences (e.g., Gangestad et al., 2002).

To conclude, in the present chapter, we found clear sex differences in the jealousy evoking effect of rival characteristics, with men responding with more jealousy to socially dominant rivals, and women to physically attractive rivals. Moreover, it seems that these rivals need not be evaluated consciously for jealousy to arise; their threat to one's current relationship can be assessed literally in the blink of an eye. The present research constitutes a valuable addition to the existing literature on the role of rival characteristics in jealousy and illustrates that the use of paradigms from social cognition may offer many opportunities for research in evolutionary psychology. Our findings not only showed that jealousy may be affected by subliminally induced characteristics that were projected on the rival, but also that the context affected the attention paid to these characteristics. More specifically, we found that women, more than men, compare their own and their rival's mate value, whereas men's jealousy responses are influenced by their satisfaction with their current relationship, showing the flexibility of human behavior and the ability to respond adaptively to specific circumstances. Moreover, we found that women's menstrual cycle also influenced their jealousy scores, which suggests that sensitivity to intrasexual competition peaks during the fertile period of a woman's menstrual cycle.

Chapter 3

Boys will be boys

The effect of a subliminally primed context depends on individual differences in sex drive [1]

[1] This chapter is based on Massar & Buunk (2009b).

Much research on human mating focuses on differences between the sexes, for example, in mate preferences (e.g. Feingold, 1992) and in jealousy (e.g. Buss et al., 1992). However, there is considerable within-sex variability in these domains. Gangestad and Simpson (2000) stress the context dependent nature of human mating psychology and argue that individuals have to make trade-offs between parenting effort (investing in a current long-term relationship) and mating effort (securing multiple short-term mating opportunities). Moreover, they argue that there are individual differences in mating strategies: some individuals will trade off parenting effort in favor of mating effort, and vice versa. For example, among the Hadza, a hunter–gatherer society in Tanzania, men provide less care to their biological children when their mating opportunities increase; that is, they trade off their parenting effort for mating effort when they have greater mating opportunities (Marlowe, 1999). More specifically, if there were more fertile women in their vicinity, the men spent less time near their children. In the present chapter, we argue that male sex drive can be regarded as a fundamental correlate of these individual differences in mating strategies.

Sex drive can be defined simply as the desire to engage in sexual activity. We suggest that this desire to seek sexual activity modulates male mating behavior. More specifically, it seems likely that men who are inclined to search for opportunities to engage in sexual activity, i.e. men with a high sex drive, will more strongly pursue a mating effort strategy, focusing their energy on attracting multiple sexual partners. In contrast, men with a low sex drive will be more likely to adopt a parental effort strategy, focusing on investment in a current (long-term) relationship. Research by Rowe, Vaszonyi, & Figueredo (1997) provides indications that sex drive is related to mating effort. Their study showed that adolescents high in mating effort were more sexually active, had a greater desire for sex and had greater sexual success with females—in other words, had a higher sex drive—than males low in mating effort. Moreover, this study provided evidence that males high in mating effort are also more inclined to engage in intrasexual competition with other males: positive correlations were found between males' mating effort and their self-reported aggressiveness and delinquency.

Thus, in general, previous research suggests that it seems likely that males with a high interest in sex and a concomitant short-term mating strategy will be relatively more

likely to engage in intrasexual competition, that is, engage in direct or indirect competition with other males for access to females. Indeed, Simpson et al. (1999) found a relationship between men's mating orientation and their intrasexual competitive tactics. Participants had to compete with a same-sex person over a lunch date with an attractive opposite-sex other by summing up reasons they should be chosen for the date. Results showed that men who required less commitment and closeness in a relationship before having sex (i.e., had a short-term mating orientation) reported more direct intrasexual competition tactics such as making direct comparisons with their rival. Men who exhibited a long-term mating orientation displayed positive self-attributions: they presented themselves as nice and kind, but did not use these direct competition tactics. The authors argue that the use of these different tactics should facilitate the different relationship orientations and goals held by these men. Moreover, Bleske-Rechek and Buss (2006) found that men's mating-effort behaviors (e.g., frequently making propositions, acting seductive, and having sex) correlated with these men's perceptions of the effectiveness of derogating a rival's attractiveness, acting macho, derogating a rival's dominance, and dominating a competitor. In other words, men high in mating effort made greater use of intrasexual competition tactics.

As Archer (2006) points out, individual differences in sex drive and mating strategies could be due to differences in circulating testosterone levels. Indications that testosterone modulates mating behavior were first found in research on seasonally breeding birds. Wingfield, Hegner, Dufty, and Ball (1990) coined the Challenge Hypothesis to explain testosterone–aggression associations in monogamous birds. This theory posits that increases in circulating testosterone levels in males are context dependent. Seasonally breeding (monogamous) birds show an elevation in testosterone at the start of the breeding season, which facilitates territory formation and courtship behavior. As competition for mates increases, monogamous birds react strongly to challenges from other males with increased testosterone production. However, when these males need to provide care to offspring, their testosterone levels drop (Wingfield et al., 1990). Especially provocative is experimental evidence showing that elevating testosterone levels in monogamous birds causes them to switch from parental to mating effort, displaying much more courtship behavior to their females and decreasing the time they spend on parental care (Hegner & Wingfield, 1987; Parisot, Tanvez, Lacroix, Vallet, Béguin, & Leboucher, 2005). Support

for the challenge hypothesis has also been found in baboons and chimpanzees (Beehner, Bergman, Cheney, Seyfarth & Whitten, 2006; Muller & Wrangham, 2004).

The challenge hypothesis suggests specific predictions about human mating behavior. One prediction is that human males would be sensitive to challenges in situations involving competition with other males. In particular, challenges that are relevant to reproduction, such as competition over a mate or competition over one's status and resources, should increase men's tendency to engage in intrasexual competition with their rivals. Following from this, we suggest that men will be most likely to engage in intrasexual competition when they are challenged in a context that is relevant to their mating strategy. Thus, we predict that men with a high sex drive will in general be more threatened by a rival than men with a low sex drive, especially when they are confronted with him in a sexual context. This will 'trigger' their tendency for intrasexual competition as in this context a rival will be perceived as a direct threat to one's mating efforts. Although in general men with a low sex drive will be less sensitive to intrasexual competition, they are hypothesized to be threatened more by a rival that is encountered in a commitment context, and who may thus constitute a threat to their parenting efforts.

In the present study, we confronted participants with a romantic rival. To emphasize the threat, we asked participants explicitly how they would feel if this rival would *outperform* them on a number of characteristics that are relevant to (male) mate value, thereby creating intrasexual competition. To avoid demand characteristics, subliminal priming was used to create either a sexual or a commitment context by exposing participants either to words relating to sex or to words relating to commitment.

Method

Participants & design

Thirty men (M = 22.4 years, SD = 3.0) at the University of Groningen took part in this study on a voluntary basis. They were randomly assigned to either the sexual primes condition or to the commitment primes condition.

Materials

The words used for the subliminal priming procedure in the sexual primes condition were *sex, passion*, *making out*, and *aroused;* the words used in the commitment primes condition were *warmth, intimate*, *attached*, and *committed*.

Previous research has shown that certain rival characteristics are more upsetting than others (Dijkstra & Buunk, 1998). To ensure that participants in the present study were sufficiently threatened by the presence of a rival, the characteristics that have been shown to evoke the most jealousy were chosen in the present study. Participants indicated on a five-point scale how upset they would be if their rival would exceed them on a number of characteristics (1 = *not upset at all*; 5 = *very upset*). We chose items that Dutch male students in previous research (Dijkstra & Buunk, 2002) considered to be threatening in a rival: having better career prospects, being more physically attractive, and being sexier. We also included items that Dutch male students considered less threatening in a rival: having a nicer and newer car, being more slender, and having a better sense of humor. It was predicted that participants would react strongly (i.e., with more upset) to the threatening rival characteristics, but not to the less threatening characteristics.

To measure participants' sex drive, the Sex Drive Questionnaire (SDQ) was used (Ostovich & Sabini, 2004). This questionnaire consists of four questions that assess participants' sex drive without necessitating that they have a romantic or sexual partner:

1. How often do you experience sexual desire? (scored on a 7-point Likert-type scale: *never*; *less than once a month*; *about once a month*; *about once a week*; *several times a week*; *daily*; *several times a day*)
2. How often do you orgasm in the average month? (*never*; *1-2 times*; *about once per week*; *several times a week*; *daily*; *several times a day*)
3. How many times do you masturbate in the average month? (*never*; *1-2 times; about once per week*; *several times a week*; *daily*; *several times a day*)
4. How would you compare your level of sex drive with that of the average person of your gender and age? (scored on a seven-point Likert-type scale anchored by *very much lower* and *very much higher*)

Because of scaling differences, these scores were transformed into z-scores. Coefficient alpha of this scale was .70.

Procedure

Participants were seated behind a computer on which all instructions and questionnaires were presented. After answering some general questions (age, education) participants were told that they were going to make an 'association task'. This task was a subliminal priming procedure adapted from Dijksterhuis (2004). Participants' task was to indicate as quickly as possible if two neutral words presented on the screen were related to each other by pressing one of two colored keys on the keyboard. However, scores on this task were not recorded, since its only purpose was to prime participants either with 'sex' or with 'commitment'.

The visible 'association' words in the task had no relation to rival characteristics, but were neutral words like *house* and *garden*. During this task, and in between the two neutral words, participants were subliminally exposed to the words relating to either sex or commitment. Each prime word was presented for 17 ms. There were four prime words for each condition, and each word was presented five times, making a total of 20 trials. A trial would consist of a neutral word (presented for 1.5 sec), a prime word (17 ms) and then another neutral word (1.5 sec), after which the participant pressed a key.

Immediately after completing the association task, participants were asked to imagine their partner coming home one day and telling them: "I found someone else". They were instructed to think about their feelings and thoughts in such a situation before continuing with the rest of the experiment. Next, participants indicated how upset they would be if their rival exceeded them on a number of characteristics and completed the Sex Drive Questionnaire. Finally, using a funneled debriefing method (Bargh, Chen & Burrows, 1996), participants' awareness of the subliminal primes was assessed. Participants indicated that they had only seen the two neutral words on the screen and that they were not aware of the subliminal priming.

Results

Relationship status

First of all, to rule out the possibility that participants' relationship status had influenced their scores on the Sex Drive Questionnaire – which could subsequently have influenced their reactions to the subliminal priming and the rival characteristics – we performed an Independent Samples T-Test. This analysis showed no significant effect: t (28) = -.35, p = .73. Participants who were at the time of the experiment in a relationship (N = 11) reported equal levels of sex drive as participants who were not in a relationship (N=19): M = -.25 and M = .15 (z-scores). Moreover, there was no significant correlation between sex drive and relationship status: (Spearman's) ρ = -.04, p = .85. Thus, we conclude that we have ruled out the possibility that participants' level of sexual desire is a proxy of their being in a sexual relationship.

Factor analysis

A Principal Component Factor Analysis with Varimax Rotation was performed on the six characteristics on which the participants had to imagine the rival outperforming them. As predicted, the analysis showed two factors. Factor 1 consisted of the items *having better career prospects*, *being more physically attractive*, and *being sexier*: α = .77, factor loadings > .80, explained variance 35.53%. Factor 2 consisted of the items *having a newer and nicer car*, *being more slender*, and *having a better sense of humor*: α = .54, factor loadings > .61, explained variance 28.75%. The factors were uncorrelated (r = -.28, *ns*). A t-test showed that participants were significantly more upset by a rival possessing factor 1 characteristics (M = 3.61, SD = .90) than by a rival that possesses factor 2 characteristics: M = 2.41, SD = .80, t(29) = 5.89, p < .001. In further analyses, the factors were used as dependent variables, with factor 1 indicating a very threatening rival and factor 2 indicating a less threatening rival.

Regression analyses

Hierarchical regression analyses with condition (sex vs. commitment) and sex drive (continuous, standardized) as predictors, and factor 1 (threatening rival), and factor 2 (less threatening rival) as dependent variables were conducted.

For the first factor - the threatening rival characteristics - the overall model was significant: R^2 = .33, $F(3, 26) = 4.27$, $p = .01$. There was no main effect of condition, $B = -.21$, $t(26) = -1.46$, *ns*. There was the expected main effect of sex drive, $B = 1.36$, $t(26) = 3.00$, $p < .01$, indicating that men with a high sex drive (+ 1SD) were more upset over the presence of their rival than men with a low sex drive (-1 SD): $M = 5.06$ and $M = 2.35$ respectively. This main effect was qualified by a significant interaction between sex drive and condition: $B = -.78$, $t(26) = -2.59$, $p = .02$. Simple slope analyses showed that whereas men low and high in sex drive did not differ in the amount of upset over a rival after priming with commitment words ($M = 4.11$ and $M = 3.71$ respectively; $r = -.24$, *ns*), men with a high sex drive reported significantly more upset over a rival ($M = 4.07$) than men with a low sex drive ($M = 2.91$) after being primed with sex-related words ($r = .63$, $p = .01$). Furthermore, men with a low sex drive reported more upset over a rival after being primed with commitment-related words ($M = 4.11$) than after priming with sex-related words ($M = 2.91$; $t(26) = -2.82$, $p < .01$). See Figure 1 for an illustration of this effect.

As predicted, regression analyses with the second factor - the less threatening rival characteristics - as the dependent variable did not yield any significant effects. The overall model was not significant: $R^2 = .08$, $F(3, 26) = .77$, *ns;* nor were the main effects of sex drive and condition, and the interaction between sex drive and condition significant (B's <-.01, ts <.09, *ns*).

Discussion

In the present chapter, we predicted that men with a high sex drive would be more sensitive to intrasexual competition and threats from rivals, and would be more inclined to follow a mating effort strategy, focusing on attracting multiple sexual partners. Men with a low sex drive however were hypothesized to be less threatened by rivals vying for their partner's attention, and to follow a parenting effort strategy, focusing on investments in their current

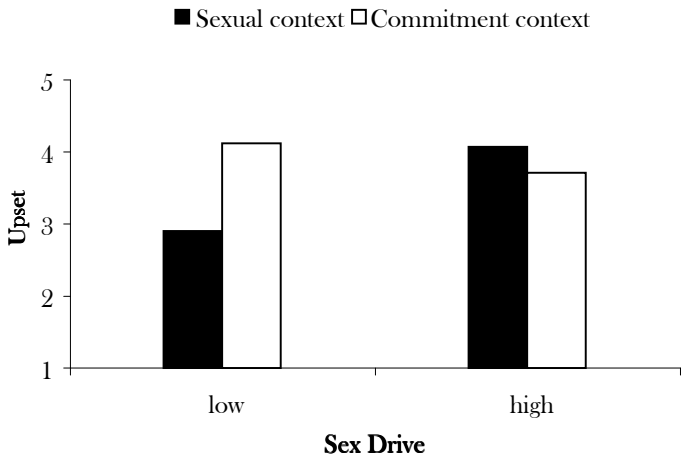

Figure 1. Upset over a rival for men low and high in sex drive after subliminal exposure to either commitment related or sex related words.

relationship. Moreover, we expected the context in which the participants were exposed to the rival to have an impact on the threat of the rival: we hypothesized that men with a high sex drive would be more threatened by the rival in a sexual context than in a commitment context, whereas the reverse was expected for men with a low sex drive.

We found results supporting our predictions: overall, men with a high sex drive were significantly more upset over the presence of a rival than men with a low sex drive, suggesting that for men with a high sex drive the rival posed a bigger challenge than for men with a low sex drive. Moreover, the results from the present study showed that it matters in which context participants are presented with the challenge of a romantic rival. Participants low and high in sex drive did not differ in their upset over the rival when they had been primed with the commitment words, but when primed with sex-related words, participants with a high sex drive were more challenged than participants with a low sex drive. Moreover, men with a low sex drive reported more upset after priming with commitment related words than after priming with sex related words. These results fit in with the hypothesis that men will be most threatened by a rival in a context that is relevant to their mating strategy. Thus, men high in sex drive are more challenged in sexual contexts since

they are focused on attracting sexual partners, whereas men low in sex drive and high in parenting effort are more focused on investment in and attention to their current relationship—even though they are overall less threatened by a rival than men high in mating effort.

Overall, we think the results from the present study suggest that the strength of men's sex drive reflects their mating strategy. We argue that men who are motivated to pursue sexual activity, would be more inclined to seek this sexual activity with multiple partners, whereas men with a low sex drive would be more likely to focus their energy and time on seeking or maintaining a long-term relationship. Moreover, there is reason to assume that sex drive is closely linked to testosterone, which in its turn has been shown to modulate mating behavior in among other species, birds and chimpanzees (Muller & Wrangham, 2004; Wingfield et al., 1990). Archer (2006) argued that differences in testosterone levels could be the underlying cause of differences in mating strategies. For example, previous research established a negative association between getting or staying married and testosterone levels, and between marital quality and testosterone levels. Moreover, men with higher levels of testosterone reported more extra-marital sexual affairs (Booth & Dabbs, 1993). Further evidence that men with a high sex drive are more focused on mating effort comes from a recent study by McIntyre et al. (2006, Study 2). These authors showed that, as the challenge hypothesis would predict, single men had higher levels of testosterone than paired men. However, men who expressed extra-pair sexual interests maintained high levels of testosterone, despite being in a romantic relationship. Thus, higher levels of testosterone seem to facilitate continued mating effort in these males. Conversely, men who provide care to their offspring are found to have decreased testosterone levels. In a study by Burnham et al. (2003), it was found that men who were in a committed, romantic relationship had 21% lower testosterone levels than men not involved in such a relationship. Moreover, this effect was found not only for married individuals, but also for unmarried men in a committed relationship, suggesting that it is male pair bonding status that is causing the decrease in testosterone levels. These and other studies indicate that testosterone seems to modulate human male behavioral allocation between mating and parenting effort.

In future research, it would be interesting to establish whether participants' scores on the Sex Drive Questionnaire (SDQ, Ostovich & Sabini, 2004) employed in the present study are correlated with their levels of circulating testosterone. In our opinion, high scores on the questions of the SDQ are indicative of high levels of circulating testosterone. Results from a 2-week diary study by Knussmann et al. (1986) showed clear associations between male levels of testosterone and the preceding sexual stimulation (from any source) or sexual activity that resulted in orgasm. Thus, if a respondent indicates high frequency of desire, masturbation and orgasm on the SDQ, it would be reasonable to assume he has relatively high testosterone levels.

Conclusion

To conclude, we feel that the present study is a valuable addition to the literature on individual differences in human mating behavior. Our results show that male sex drive can be regarded as an indicator of one's tendency to engage in intrasexual competition. Moreover, we used subliminal priming to create the context, which strengthens the hypothesis that men's responses to challenges from rivals are not fully conscious. It seems that men, depending on their natural inclination to engage in intrasexual competition, use subtle contextual cues to gauge whether a particular rival is a direct threat to their mating efforts.

Chapter 4

Rivals in the mind's eye

Jealous responses after subliminal exposure to body shapes [1]

[1] This chapter is based on Massar & Buunk (2009).

Generally, people do not like admitting jealous feelings. But from a functionalist perspective, jealousy may be an adaptive response. Evolutionary psychologists assume that human cognitive and motivational functioning is directed by mental mechanisms which have evolved to solve specific adaptive problems related to survival and reproduction. Stimuli relevant to fundamental motives like reproduction and survival are thought to be selectively processed (Maner, Gailliot, Rouby, et al., 2007). For humans, an enduring pair bond not only increases the survival chances of individuals, but also of their offspring. It is therefore important to guard one's mate from interlopers. Indeed, evolutionary psychologists hypothesize that jealousy has evolved to alert the individual particularly to take action to prevent a mate from abandoning the relationship (Buss, 1994). In general, jealousy can be conceptualized as part of a coordinated system of cognitive, affective, physiological and behavioral responses aimed at guarding one's mate from potential intrasexual competitors (Buunk et al., 2007; Maner & Shackelford, 2007), which, ultimately, is of importance to reproductive success.

Rival evaluation

When confronted with an intrasexual competitor, people will try to assess the threat this rival poses to their relationship. Research has shown that the degree of jealousy evoked by rivals is dependent on the characteristics they possess (e.g., DeSteno & Salovey, 1996; Dijkstra & Buunk, 1998, 2002). Since men tend to value attractiveness and youthfulness in a potential mate more than women do, a woman confronted with a rival should be most jealous when this rival is physically attractive. On the other hand, men are most jealous when the rival possesses status-related characteristics such as social dominance, since women seem to have an evolved preference for men displaying cues indicative of the ability to provide. Indeed, research has repeatedly established that precisely these sex differences in the rival characteristics that evoke jealousy do occur (e.g., Dijkstra & Buunk, 1998; Yarab & Allgeier, 1999), and that these occur in different cultures (Buss et al., 2000), and among heterosexuals as well as homosexuals (Buunk & Dijkstra, 2001).

The central idea tested in the present research is that during the course of human evolution, sensitivity to rival characteristics has evolved into such a basic mechanism that these characteristics may be perceived even outside conscious awareness, e.g. that rivals

may be evaluated in the blink of an eye. More specifically, it is assumed that exposure of mere milliseconds to a rival is sufficient to evoke a jealous response in participants. Evidence that social stimuli relevant to mating and mate-guarding may be processed selectively, and at a very early stage, comes from Maner, Gaillot, Rouby, et al. (2007) and from Maner, DeWall and Gailliot (2008). In several experiments, these authors showed that when a mating motive had been induced, participants' attention 'stuck' to relevant stimuli such as attractive members of the opposite sex, e.g. possible mates, or to attractive members of the same sex, e.g. rivals. In the present study, it is assumed that rival evaluation takes place during the early stages of social perception. We use a subliminal priming paradigm to investigate whether very brief visual exposure to different body shapes – mere milliseconds – can influence participants' jealousy. Subliminal priming is used to investigate natural, immediate and unintentional effects in an individual's responses to certain stimuli (Bargh, 1994). As such, this method provides an opportunity to assess participants' responses to a rival while circumventing demand characteristics and socially desirable answers. We assume that even though they will not be consciously aware of being exposed to a rival, participants will process the visual information selectively, that is, we expect that participants will report more jealousy after exposure to a rival with an attractive body shape than after exposure to a rival with an unattractive body shape.

Body Shapes

We chose the waist-to-hip ratio (WHR), the circumference of the waist relative to the hips, as a relevant rival characteristic for women. Since cues to a woman's reproductive fitness were not readily available, ancestral males were thought to have evolved a preference for morphological features of the female body that signal reproductive fitness (Singh, 1993a). WHR is considered an indicator of a woman's reproductive capability and health as it is the result of high levels of estrogen that cause more fat to be deposited on the buttocks and hips than on the waist. A low ratio, between 0.67-0.80 results in a curvaceous, hour-glass shaped figure and is considered most attractive, and a WHR around 0.7 is considered an 'ideal' female body shape. Ratings of female attractiveness are significantly correlated with WHR (Singh, 1993a, 1993b; Streeter & McBurney, 2003), and WHR has been shown to be a reliable morphological indicator of the levels of sex hormones (Singh, 1993a). For

example, a study by Jasieńska, Ziomkiewicz, Ellison, Lipson and Thune (2004) showed that women with large breasts and a relatively low WHR – the Barbie-shaped women considered particularly attractive by Western men – have higher fecundity as measured by daily assessments of 17-β-oestradiol and progesterone levels than women with high WHRs and small breasts. Moreover, WHR has been linked with the risk of major diseases and premature mortality (Furnham, Dias, & McClelland, 1998). Concerning jealousy, there is evidence from paper-and-pencil studies that rivals with a relatively low WHR evoke more jealousy in women than in men, and that women pay more attention to the waist, hips, and legs in evaluating their rivals (Buunk & Dijkstra, 2001; Dijkstra & Buunk, 2005).

WHR as a measure of a woman's attractiveness has been criticized in favor of body weight as the defining feature of physical attractiveness (see for example Swami & Furnham, 2008). Indeed, WHR and body weight are correlated in women (Singh, 1993b) and in certain cultures – especially those where there is a risk of seasonal food shortage – males prefer a high over a low WHR in women (e.g. Marlowe & Wetsman, 2001). However, it appears that at least in developed Western societies WHR seems to predict health and physical attractiveness very well, and in the same manner as BMI does (Weeden & Sabini, 2005).

With respect to men, the present study focused upon the shoulder-to-hip ratio (SHR). Male physical attractiveness is largely determined by body parts such as the chest and shoulders, and men whose torsos have an inverted triangle shape, that is men who have broad shoulders and narrow hips, are considered most attractive (Fan, Dai, Liu &Wu, 2005; Franzoi & Herzog, 1987). This body shape is indicative of larger physical strength and muscular development in the upper body. Men with a high SHR are also perceived as being higher in both social and physical dominance than men with a low SHR (Dijkstra & Buunk, 2001). A male's waist also plays a role in determining physical attractiveness: research has shown that a male WHR of 0.9 is considered the optimal ratio and that increasing WHRs decrease a male's attractiveness (Dijkstra & Buunk, 2005). Concerning jealousy, there is evidence from paper and pencil studies that rivals with a relatively high SHR evoke more jealousy in men than in women (Buunk & Dijkstra, 2001), and that men say that they pay more attention to their rivals' shoulders, chest, and belly (Dijkstra & Buunk, 2001).

Additional evidence suggests that rivals with a low WHR may be particularly threatening for women, and rivals with high SHR may be particularly threatening for men. A study by Hughes and Gallup (2003) showed that both men with a high SHR and women with a low WHR reported earlier experiences with sex and more sexual partners. Moreover, relevant to the present study, these men and women were also more prone to infidelity: they reported more extra-pair copulations (EPCs) and more frequently having been an EPC partner, characteristics which could make them threatening rivals (Hughes & Gallup, 2003). Furthermore, there is some evidence that judgments of the attractiveness of varying waist-to-hip ratios can be made during very short exposure times (Schützwohl, 2006). In this study, male participants were exposed for 1250 ms to pairs of Singh's (1993a) line drawings of figures with varying WHR's (0.5, 0.7 and 0.9), and were asked to indicate which of the two figures they thought were most attractive and healthy. As in Singh's (1993a) original study, participants chose the figure with the WHR of 0.7 as the most attractive and healthy. Moreover, judgments in favor of this figure were made most rapidly.

The present research

To summarize, the present chapter examined if rival evaluation may be an unconscious process, engaged in automatically whenever a rival is encountered. To this end, line drawings of figures with either an attractive body shape (a low WHR for women and a high SHR for men) or an unattractive body shape (a high WHR for women and a low SHR for men) were subliminally presented to participants. After being primed, participants read a jealousy evoking scenario, describing someone flirting with their partner. Next, their jealousy was assessed in response to a scenario developed by Dijkstra and Buunk (1998) and employed in many studies. It was expected that both men and women would report more jealousy after being exposed to the figure with the attractive body shape.

Study 4.1

Method

Participants and design

Thirty four men (mean age = 22.0 years, SD = 3.0) and 54 women (mean age = 21.6, SD = 3.0) at the University of Groningen took part in this study and received course credit for their participation. They were randomly assigned to either the attractive body condition or the unattractive body condition.

Materials

The stimuli used in the present study were line drawings originally developed by Singh (1993a) and modified by Dijkstra and Buunk (2001). Whereas the original drawings by Singh varied only waist-to-hip ratio and body weight, Dijkstra and Buunk (2001) reasoned that body taper contributes to male mate value. Therefore, they also varied the shoulder-to-hip ratio (SHR) in the line drawings. To establish the average and the ideal shoulder-to-hip ratio for men, they measured the circumference of male shoulders and hips in the local population of young adults, as well as the hips and shoulders of male models. This resulted in an average SHR of 1.2 (local population) and an ideal SHR of 1.4 (male models). Thus, for male participants in the present experiment the picture that was rated highest in attractiveness and dominance in the Dijkstra and Buunk (2001) study was chosen as the attractive body prime. This was the figure with the high SHR (1.4) and low WHR (0.9). For the unattractive body prime, we used the figure with the low SHR (1.2) and the high WHR (1.1), which was rated least attractive and least dominant in the Dijkstra & Buunk (2001) study. For the female participants, we used the original Singh (1993b) line drawings of the figures with normal body weight. For the attractive body prime we used the figure with the WHR of 0.7 and for the unattractive body prime we used the figure with the WHR of 0.9. See figure 1 for the stimuli used in this experiment.

The primes were flashed in 15 of the 60 experimental trials. In the practice trials and in the remainder of the 45 experimental trials participants were exposed to geometrical shapes (circles, triangles and squares; see figure 2), which also were presented for 60 ms.

These shapes were of the same size as the priming stimuli and consisted of black line drawings on a white background.

After the subliminal priming, jealousy in response to a scenario was measured using a jealousy sliding scale on the computer, with endpoints 0 (*not jealous at all*) and 100 (*extremely jealous*). Participants could use the mouse to slide a knob to the position on the scale that best indicated their feelings.

Priming procedure

Participants were seated behind a computer on which all instructions and questionnaires were presented. After answering some general questions (age, education) participants were told they were going to take a reaction time task. This task was a parafoveal priming procedure adapted from Chartrand and Bargh (1996). The instructions were given through instructions on the screen. Participants were explained they were to be seated 80-100 cm from the computer screen and sit erect on their chair. This was done to make sure the stimuli were presented outside participants' perceptual field. Two keys on the keyboard were labeled *L* and *R*, and participants were instructed to press the *L* key whenever they saw a flash on the left side of the screen, and the *R* key whenever they saw a flash on the right side of the computer screen. A fixation point consisting of an asterisk (*) was presented continually in the center of the screen and participants were told to focus on this fixation point throughout the task because of the unpredictable location and timing of the stimuli on the screen. To get familiar with the procedure, participants were given 15 practice trials, in which only the geometrical shapes were flashed. After the practice trials, the participants completed the 60 experimental trials. In total, the task took them approximately 10 minutes to complete.

All pictures presented on the computer screen appeared as black on a white background. Both the geometrical shapes and the priming stimuli were presented for 60 ms. Each picture was immediately followed by a 60 ms masking picture of black slanted stripes on a white background. The stimulus pictures and the mask appeared randomly at one of four parafoveal locations on the screen (for details, see Chartrand and Bargh, 1996). Intervals between pictures varied from 2 to 7 seconds. Both the random presentation in one of the four parafoveal regions and the random sequence of time intervals between

stimulus presentations ensured that it was impossible for participants to learn or predict the next presentation of the stimuli.

Finally, participants' awareness of the subliminal primes was assessed using a funneled debriefing procedure (Bargh et al., 1996). Participants indicated they had not been aware of either the purpose of the study or the content of the flashes.

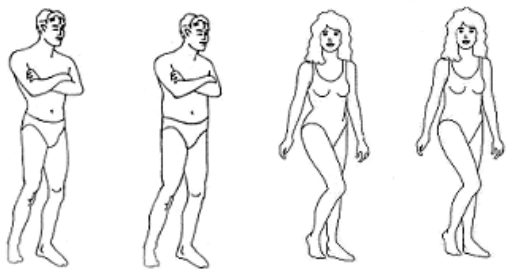

Figure 1. Stimuli used in study 4.1. Male high SHR (1.4)/low WHR (0.9); Male low SHR (1.2)/high WHR (1.1); Female low WHR (0.7); Female high WHR (0.9).

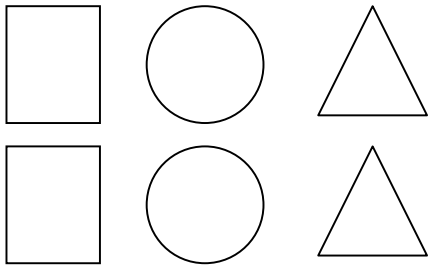

Figure 2. Geometrical shapes used in studies 4.1 and 4.2.

Results

A 2 (participant sex) by 2 (prime: attractive body/unattractive body) ANOVA was performed with the jealousy slider as the dependent variable. There were no main effects of prime ($F(1, 84) = 2.13$, *ns*) or of participant sex ($F(1, 84) = 1.93$, *ns*). The interaction between participant sex and prime was significant however: $F(1, 84) = 5.51$, $p < .05$, $\eta^2 = .06$. Men who had been primed with the attractive body shape reported significantly more jealousy (M = 77.43) than men who had been primed with the unattractive body shape (M = 61.03; $t(32) = -2.40$, $p = .02$). However, women were not affected by the subliminal primes: they reported equal amounts of jealousy after being primed with the attractive body shape (M = 61.33) than after being primed with the unattractive body shape (M = 65.17; $t(52) = .72$, *ns*).

Discussion

The results from study 4.1 show that men's jealousy is influenced by the subliminal primes: men report significantly more jealousy after being exposed to the attractive body shape than after being exposed to the unattractive body shape. This result is in line with our expectations and points to an unconscious mechanism with which men seem to evaluate each other's physical dominance and physical attractiveness. For women however, the primes did not seem to have the intended effect. We reasoned that this could be due to the stimuli. There is less contrast between the line drawings depicting female body shapes with a WHR of 0.7 or 0.9 than between the male body shapes. Even when evaluated consciously, it is hard to detect which features differ between these drawings. We suspected that the drawings could be too detailed to be evaluated in mere milliseconds. Moreover, there is evidence that women make more errors than men in correctly localizing a target pattern in the visual field, especially when it is presented in the parafoveal region (Efron, Yund & Nichols, 1987). Therefore, in the second experiment that was conducted only among women it was decided to crop the pictures, so that the focus would be more on the waist and hips and participants would not be distracted by the other features (face, hair, limbs) of the line drawings.

Study 4.2

Method

Participants and design

Seventy three women (mean age = 22.4, SD = 4.6) at the University of Groningen participated in this study in return for € 6,-.

Procedure

The procedure of the second study was identical to that of Study 1, with the exception that in Study 2 the line drawings of the figures with the attractive and unattractive WHR were cropped: possibly distracting features like limbs, face and hairstyle were removed so that the focus would be on the waist and hips (see figure 3). As in Study 1, participants indicated no awareness of the purpose of the study or the content of the flashes.

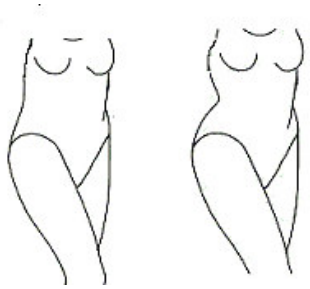

Figure 3. Stimuli used in study 4.2: Female high WHR (0.9); Female low WHR (0.7).

Results

A t-test was performed with the jealousy slider as the dependent variable. This showed the expected main effect of the prime: $t(71) = 1.98$, $p = .05$, $\eta^2 = .05$. Women who were exposed to the attractive body shape reported significantly more jealousy (M = 74.18) than women who were exposed to the unattractive body shape (M = 65.86).

General discussion

Evolutionary theory suggests that to facilitate reproduction, significant emotional stimuli such as mating partners or signals of threats should be particularly effective cues for capturing attention and influencing subsequent behavior (Maner, Gaillot, Rouby, et al., 2007). We reasoned that during the course of human evolution, sensitivity to rival characteristics has evolved such that these characteristics may be perceived even outside conscious awareness, e.g. that rivals may be evaluated in the blink of an eye. Based on previous research on the bodily features of rivals that evoke jealousy (Dijkstra & Buunk, 2001, 2005), it was assumed that women would be most jealous after exposure to a rival with an hourglass-shaped figure, e.g. a WHR of 0.7. Since male physical attractiveness is largely determined by physical dominance, which in turn is characterized by body taper, it was hypothesized that male jealousy would be evoked by exposure to a rival with broad shoulders and a small waist, e.g. a SHR of 1.4.

The results from the present studies are in line with our expectations. Without explicit awareness of the presence of a stimulus, participants were influenced by the exposure to a rival: both men and women indicated they would experience more jealousy when imagining the scenario if they previously had been primed with an attractive body shape than when they had been primed with an unattractive body shape. The present research hereby replicates previous research (Dijkstra & Buunk, 2005), but takes it one step further: participants in the present experiment indicated they were not aware of the primes, yet they were influenced by them when they imagined how they would react to the jealousy evoking vignette. It seems that body shape is such a powerful cue to a rival's mate value, that it is capable of evoking jealous feelings outside conscious awareness. These results fit in with the idea that it is likely that human cognitive functioning evolved to be responsive to stimuli that are relevant to protecting one's relationship from intrasexual competitors and that attention to these stimuli takes place during the early stages of social perception. Indeed, studies by Maner, Gaillot, Rouby, et al. (2007) suggest that jealousy promotes a basic perceptual vigilance to potential intrasexual competitors – especially for competitors who are physically attractive and especially among perceivers for whom intrasexual rivalry is a salient concern. Although we agree with Barrett, Frederick, Haselton

and Kurzban (2006) that evolved mechanisms are not necessarily also automatic, we would suggest that the results from the present study point to an automatic component in rival evaluation – in the sense that it functions with high efficiency, without awareness of the stimuli and without participants' control of the influence of the primes on subsequent responses (Bargh, 1994).

One could argue that the stimuli used in the present experiment lack ecological validity and that they are unrealistic depictions of male and female bodies. Indeed, the line drawings used in the present experiments have been criticized for precisely these reasons by several authors (Furnham & Reeves, 2006; Tassinary & Hansen, 1998). However, if the line drawings would be totally unrealistic and ecologically invalid, it is unlikely the differences between the conditions in the experiments we report here would have been found. However crude these stimuli may be, in the present experiments, the attractive body shapes evoked more jealousy than the unattractive body shapes. Future research needs to establish whether the results found in the present study extend to exposure to more naturalistic stimuli such as photographs of men and women wearing clothes.

Many researchers also criticize Singh's (1993a) contention that WHR functions as a 'first-pass filter' of attractiveness (see for example Swami, Antonakopoulos, Tovée & Furnham, 2006; Tovée & Cornelissen, 2001). According to Singh (1993a) only after a woman has passed this filter (e.g. has been judged attractive on the basis of her WHR) will other factors such as BMI and facial attractiveness be taken into account when judging her attractiveness as a mate. According to the critics (Swami et al., 2006; Tovée & Cornelissen, 2001), it is actually a female's body mass (BMI) that is the primary predictor of her attractiveness. In several studies using different methodological designs and stimuli, several authors (e.g. Tassinary & Hansen, 1998; Tovée & Cornelissen, 2001) showed that when a woman's weight is taken into account, the contribution of WHR to attractiveness ratings is small. We agree with these authors that most studies reporting a positive relationship between WHR and attractiveness ratings find these results only when controlling for BMI. However, again we want to point out that it is unlikely we would have found the results we report here if WHR was irrelevant to physical attractiveness, especially considering the size of the difference in reported jealousy between conditions. For future studies, it would be interesting to examine whether varying BMI in the line drawings affects the influence of

WHR on participants' jealousy, and whether differences in BMI also influence participants' jealousy scores subconsciously.

Conclusion

In conclusion, the results from the present studies point to the possibility of an automatic component in the tendency to be threatened by physically attractive rivals, for both men and women. It seems that participants are able to make fast and frugal first impressions of a rival using body shape as a cue to determine the threat this person would pose to their relationship. It may very well be that Singh (1993a) was right after all: only after a person's body shape is assessed, do other variables influence attractiveness ratings – or in this case, jealousy. Although we are hesitant to draw too strong conclusions about the evolved nature of this ability, it is very well possible that being able to respond quickly and adequately to the threat posed by a rival by becoming jealous enhances one's reproductive fitness and as such is very adaptive.

Chapter 5

Judging a book by its cover

The effects of subliminal exposure to facial attractiveness on jealousy [1]

[1] This chapter is based on Massar & Buunk (2009c).

Finding a mate who will enhance one's genetic survival by reproducing successfully is one of the major problems that humans face. Since the traits a partner brings to the relationship influences one's reproductive success, it is thought that humans have evolved to prefer those traits that connote a high mate value. From an evolutionary point of view one can predict that based on the asymmetry in the costs of human reproduction, men and women differ in the characteristics they value in a mate (Trivers, 1972). Women seem to have an evolved preference for men who are able to provide them and their offspring with sufficient resources and protection. As a man who has a higher position in the social hierarchy is better able to obtain resources, a man's mate value is determined for a large part by characteristics that signal his ability to acquire social status, such as assertiveness, initiative, extraversion and self-confidence (e.g., Buss, 1989, 1994; Kenrick et al., 1990; Fletcher et al., 2004). On the other hand, as women invest relatively direct physiological resources in their offspring (e.g., gestation and lactation), men seem to have an evolved preference for women who are able to provide these direct investments, i.e. physically attractive women. In ancestral times, physical attractiveness would have been a cue to a woman's health and fertility and a woman's mate value is determined more by the attractiveness of her face and body (e.g., Buss, 1989, 1994; Kenrick et al., 1990; Townsend & Levy, 1990b; Fletcher et al., 2004).

It is thought that the function of jealousy is to alert the individual to take action to prevent a mate from abandoning the relationship. Because those individuals who experienced and acted on their jealous feelings were most likely to prevent the dissolution of their pair bond, jealousy has evolved as an inherited tendency (Buss, 1994; 2000). Jealousy arises when individuals perceive a threat to their relationship due to an actual or imagined rival (Dijkstra & Buunk, 2002; DeSteno & Salovey, 1996). Because the presence of a rival is a defining and necessary condition for jealousy to arise, feelings of jealousy are assumed to be competitive in nature. The person who notices that his or her partner is attracted to a third person is likely to see this person as a rival and will experience a sense of competition. As numerous accounts of *crimes passionnels* detail, this competition can take on extreme forms. In most cases however, these feelings of competition instigate primarily a social comparison process, whereby one's traits and qualities are compared with those of the rival (Broemer & Diehl, 2004; Dijkstra & Buunk, 2002; DeSteno & Salovey,

1996). Comparisons will be made in particular on dimensions contributing to a rival's mate value, that is, characteristics that make the rival an attractive potential partner for one's mate. Rivals with a high mate value are particularly threatening (Buss et al., 2000). Since the characteristics that would make one a desirable partner are also the characteristics that make one a threatening rival, when confronted with a rival women should be most jealous when this rival is physically attractive, and men should be most jealous when the rival possesses status-related characteristics such as social dominance. Indeed, research has repeatedly established that precisely these sex differences in the rival characteristics that evoke jealousy do occur (Yarab & Allgeier, 1999; Dijkstra & Buunk, 1998), and that these occur in different cultures (Buss et al., 2000), among heterosexuals as well as homosexuals (Buunk & Dijkstra, 2001; Dijkstra & Buunk, 2002), though in particular in response to emotional infidelity (Buunk & Dijkstra, 2004). Moreover, these rival characteristics evoke jealousy even outside individuals' awareness (Massar, Buunk, & Dechesne, 2008).

Facial attractiveness

An evolutionary view on human mating and reproduction holds that when members of a species discriminate between potential mates on the basis of their physical appearance, as humans do, it is reasonable to assume that this discrimination reflects certain adaptations that were responsive to cues that indicated mate value in our evolutionary history (Thornhill & Gangestad, 1999). Thus, choosing a physically attractive mate over a physically unattractive mate is assumed to provide reproductive benefits. Indeed, research has shown that physical attractiveness is – at least for women – positively associated with health and fertility (Jasieńska et al., 2004; Singh, 1993). Moreover, previous research on rival characteristics has shown that a rival's body build influences feelings of jealousy (Massar & Buunk, 2009; Buunk & Dijkstra, 2005; Dijkstra & Buunk, 2001). More specifically, in men, a rival with broad shoulders and narrow hips – a high shoulder-to-hip ratio (SHR) - evokes more jealousy than a rival with narrow shoulders and broad hips – a low SHR. For women, a rival with a waist-to-hip ratio of 0.7 is considered most jealousy-evoking, whereas a rival with a broader waist evokes less jealousy. Again, these effects are also found when individuals are exposed to a rival outside conscious awareness, through the mechanism of subliminal priming (Massar & Buunk, 2009). But besides body shape,

one other aspect of physical attractiveness strongly influences one's mate value: one's facial attractiveness.

Both within and across cultures, common standards of (female) facial attractiveness are shared by both men and women from different social classes (for a review see Langlois, Kalakanis, Rubenstein, Larson, Hallamm, & Smoot, 2000). This high consensus in attractiveness ratings would suggest that there are biologically based standards of beauty. Further evidence for this reasoning comes from studies that show that early on in human development, before cultural standards of beauty are likely to have developed, a preference for attractive faces over unattractive faces emerges (Slater, Quinn, Hayes, & Brown, 2000; Rubenstein, Kalakanis, & Langlois, 1999). Taken together, these studies suggest that facial attractiveness could be a signal of physical condition. Indeed, certain facial traits such as symmetry are found to be related to an individuals' health. Symmetry is thought to indicate genetic quality, and an ability to withstand deleterious influences from the environment such as toxins and pathogens (Møller, 1998). For example, several studies have shown that symmetrical faces are considered to be more attractive (Penton-Voak, Jones, Little, Baker, Tiddeman, Burt, & Perrett, 2001; Scheib, Gangestad, & Thornhill, 1999) and that asymmetrical men and women report more health problems (Thornhill & Gangestad, 2006). It appears that attractiveness is not only related to physical condition, but also to social standing and behavior. As Langlois et al. (2000) found in their meta-analysis, being attractive is strongly related to being popular and to being (socially) successful. Facial attractiveness has also been found to be positively related to intelligence, performance and adjustment in children and to both dating and sexual experience in adults (Langlois et al., 2000). Furthermore, and relevant to the present chapter, Rhodes, Simmons, and Peters (2005) found that women with attractive faces had more long-term mating success and became sexually active earlier in life than women with unattractive faces.

Assuming that facial attractiveness is indeed indicative of an individual's health and reproductive fitness, an evolutionary view on mating would suggest that being attractive is especially relevant to women, since these are the characteristics men value in a mate (Buss, 1989). Indeed, several studies have found that female faces are judged to be more attractive than male faces (Fisher, 2004; Bernstein, Lin, & McClellan, 1982). Moreover, since mate selection is thought to drive intrasexual selection in the opposite direction (Darwin, 1871)

and since facial attractiveness is one of the main criteria men use to select a mate, it is probable that women compete with each other on this dimension. Indeed, research has shown that women derogate each other's attractiveness (Fisher, 2004), and that when recalling reputation damaging gossip, cues about other women's attractiveness are remembered best (De Backer, Nelissen, & Fisher, 2007). In a similar vein, as mentioned before, a physically attractive rival evokes most jealousy in women (Dijkstra & Buunk, 1998; Massar et al., 2008), especially when physical attractiveness is operationalized as facial attractiveness.

The present research

In sum, facial attractiveness is an important mate selection criterion for men, as well as the definitive characteristic women use to evaluate – and derogate – their sexual rivals. In view of the centrality of facial attractiveness in women's rival evaluation and the importance of rival evaluation for one's reproductive success, we assume that during the course of human evolution, facial attractiveness may have evolved to become perceived even outside conscious awareness. To test this assumption, in the present chapter we will expose participants subliminally to photographs of attractive or unattractive rivals (study 5.2). However, we first report a study in which the primes for the subliminal priming were rated by men and women on attractiveness, dominance, sexiness and their threat to women's relationships (study 5.1).

Although to our knowledge the use of subliminal priming in jealousy research is new, numerous studies in social cognition suggest that people may evaluate objects or persons as 'good' or 'bad', and subsequently be influenced in their person judgments and attitudes by these primes, without being consciously aware of their presence (e.g., Fazio et al., 1986; Devine, 1989; Dijksterhuis, 2004; Ferguson et al., 2005). Indeed, relevant to the present research, a study by Olson and Marshuetz (2005, experiment 1) showed that participants who had been exposed to photographs of faces for only 13 ms were accurate in judging the attractiveness of these faces. Even though they indicated no awareness of the stimuli, they judged the attractive faces as significantly more attractive than the unattractive faces. In the present chapter we predict that women will report more jealousy after exposure to a photograph of an attractive woman than after exposure to an unattractive

woman (study 5.2). In this study we decided to focus only on women, since facial attractiveness is of less importance to male intrasexual competition.

In addition to measuring participants' jealousy with the jealousy slider used in previous experiments (Massar et al., 2008; Massar & Buunk, 2009) for exploratory purposes we also assessed a number of jealousy related emotions (worry, anger, sadness) to gauge participants' reactions to the jealousy-evoking scenario and the rival characteristics. Previous research has shown that different emotions are associated with different types of infidelities (Buunk & Dijkstra, 2004). In a study by Buunk and Dijkstra (2004) when men and were told to imagine their partner committing an act of sexual infidelity, they reported feeling more angry and sad than when they imagined their partner committing an act of emotional infidelity, which in turn evoked feelings of threat and worry. The scenario used in the present research has been shown to be a valid description of a real-life jealousy-evoking situation. We are interested to see whether in addition to evoking jealousy, it has an effect on other emotions. First of all, however, we describe a study (study 5.1) in which we pre-tested the stimuli used in our subliminal priming experiment (study 5.2).

Study 5.1

Method

Participants

Twenty nine participants (19 men, 10 women) were randomly approached and participated voluntarily in this study.

Materials and procedure

The pictures were downloaded from the internet: one of an attractive female and one of an unattractive female. The pictures were of approximately the same size, showed only faces and were presented to participants in grayscale. See Figure 1 for the stimuli.

Participants evaluated both the unattractive female and the attractive female. They indicated for each picture on a seven-point Likert-type scale ([1] = not at all, [7] = very much) how attractive, dominant, and sexy they thought the person in the picture was. We

also asked how threatening the person in the picture would be to other women if she would flirt with someone's partner.

Results

A repeated measures ANOVA on the characteristic *attractiveness* with the attractiveness of the target as the within-subjects factor and participant sex as the between-subjects factor revealed a main effect of the factor: Participants indicated they thought the individual in the attractive female picture was significantly more attractive than the individual in unattractive female picture: $F(1,27) = 92.17$, $p < .001$, $\eta^2 = .77$; M = 5.55 and M = 2.79 respectively. There was no main effect of participant sex: $F(1,27) = .78$, *ns*, $\eta^2 = .03$. There also was no significant interaction between participant sex and the factor ($F(1,27) = 2.61$, $\eta^2 = .09$).

A repeated measures ANOVA on the characteristic *dominant* with the attractiveness of the target as the within-subjects factor and participant sex as the between-subjects factor revealed a main effect of the factor: Participants indicated they thought the individual in the attractive female picture was significantly more dominant than the individual in the unattractive female picture: $F(1,27) = 41.78$, $p < .001$, $\eta^2 = .61$; M = 4.41 and M = 2.55 respectively. There was no main effect of participant sex; $F(1,27) = .01$, *ns*, $\eta^2 = .00$. Again, there was no interaction between the within-subjects factor and participant sex ($F(1,27) = 1.78$, *ns*, $\eta^2 = .06$).

A repeated measures ANOVA on the characteristic *sexy* with the attractiveness of the target as the within-subjects factor and participant sex as the between-subjects factor revealed a main effect of the factor: Participants indicated they thought the individual in the attractive female picture was significantly sexier than the individual in the unattractive female picture: $F(1,27) = 124.97$, $p < .001$, $\eta^2 = .82$; M = 5.93 and M = 2.48 respectively. There was no main effect of participant sex; $F(1,27) = .004$, *ns*, $\eta^2 = .00$. Again, there was no interaction between the within-subjects factor and participant sex ($F(1,27) = 1.73$, *ns*, $\eta^2 = .06$).

Finally, a repeated measures ANOVA on the characteristic *threatening to women* with the attractiveness of the target as the within-subjects factor and participant sex as the between-subjects factor revealed a main effect of the factor: Participants indicated they

thought the individual in the attractive female picture was significantly more threatening to other females (and their relationships) than the individual in the unattractive female picture: $F(1,27) = 140.87$, $p < .001$, $\eta^2 = .84$; M = 5.41 and M = 2.28 respectively. There was no main effect of participant sex: $F(1,27) = .12$, *ns*, $\eta^2 = .004$. However, there was a significant interaction between participant sex and the factor ($F(1,27) = 5.46$, $p < .05$, $\eta^2 = .17$).

From these analyses we conclude that the picture we had chosen as the attractive female stimulus was indeed regarded by both male and female participants as more attractive, dominant and sexy than the unattractive female stimulus picture. But, specifically interesting to our present research, the attractive female was also considered to be more threatening to women and their relationships, by both men and women. We conclude that the attractive female would thus be a more attractive mate to a man than the unattractive female. But more importantly, she would also be a more threatening rival to a woman. In conclusion, we decided the stimulus pictures were suitable to use as subliminal primes in study 5.2.

Study 5.2

Method

Participants and design

All stimuli and procedures were approved by the Ethical Committee of Psychology of the University of Groningen. Forty women (mean age = 20.78, SD = 4.26) took part in this study and received course credit for their participation. Only participants who were at the time of the experiment in a relationship were invited to participate. They were randomly assigned to either the attractive or the unattractive condition. None of the participants was aware of the purpose of the study and none had seen the stimulus material prior to the experiment.

Materials and procedure

As priming stimuli we used the photographs of the attractive and the unattractive female (see study 5.1, this chapter). The priming stimuli were flashed in 15 of the 60 experimental trials. In the practice trials and in the remainder of the 45 experimental trials participants were exposed to geometrical shapes (circles, triangles and squares), which also were presented for 60 ms. These shapes were of the same size as the priming stimuli and consisted of black line drawings on a white background.

After completing the parafoveal priming task, participants read a shortened version of the scenario developed by Dijkstra and Buunk (1998). Participants were told to visualize the situation described in the vignette before continuing with the experiment. The vignette read as follows:

You are at a party with your boyfriend and you see an unfamiliar woman walk up to him. She starts flirting with him. He seems to like it, and starts flirting back.

The next part of the experiment consisted of the jealousy slider, on which participants could indicate how jealous they would feel if the situation described in the scenario would happen to them. The slider had endpoints 0 (*not jealous at all*) and 100 (*extremely jealous*). Participants could use the mouse to slide a knob to the position on the scale that best indicated their feelings.

To check whether the subliminal primes had influenced participants' self-evaluations, which in turn could be responsible for differences in jealousy scores, participants indicted how inferior they felt after imagining the scenario (1 = *not at all* and 5 = *very strong*). Moreover, in addition to measuring jealousy with the slider, we used a multiple adjective rating scale, the sum of which is sometimes used as a score for jealousy (DeSteno & Salovey, 1996). Participants rated how suspicious, betrayed, worried, distrustful, jealous, rejected, hurt, anxious, angry, threatened, and sad on a five-point scale with 1 = *not at all* and 5 = *very strong*. Cronbach's alpha of these 11 adjectives was = .95.

Finally, participants' awareness of the subliminal primes was assessed. In a funneled debriefing procedure (Bargh et al., 1996) they were asked what they thought the purpose of the study was, whether they thought any tasks in the study were related, whether anything in

the study seemed strange or suspicious to them, and what they thought the content of the flashes had been. Participants indicated they had not been aware of the purpose of the study or the content of the flashes.

Parafoveal Priming procedure

Participants were seated behind a computer on which all instructions and questionnaires were presented. After answering some general questions (age, education) participants were told they were going to make a reaction time task. This task was a parafoveal priming procedure adapted from Chartrand and Bargh (1996). The instructions were given through instructions on the screen. Participants were explained they were to be seated 80-100 cm from the computer screen and sit erect on their chair. This was done to make sure the stimuli were presented outside participants' perceptual field. Two keys on the keyboard were labeled *L* and *R*, and participants were instructed to press the *L* key whenever they saw a flash on the left side of the screen, and the *R* key whenever they saw a flash on the right side of the computer screen. A fixation point consisting of an asterisk (*) was presented continually in the center of the screen and participants were told to focus on this fixation point throughout the task because of the unpredictable location and timing of the stimuli on the screen. To get familiar with the procedure, participants were given 15 practice trials, in which only the geometrical shapes were flashed. After the practice trials, the participants completed the 60 experimental trials. In total, the task took them approximately 10 minutes to complete.

All pictures presented on the computer screen appeared as black on a white background. Both the geometrical shapes and the priming stimuli were presented for 60 ms. Each picture was immediately followed by a 60 ms- masking picture. This picture consisted of a scrambled (unrecognizable) version of the stimulus pictures. The stimulus pictures and the mask appeared randomly at one of four parafoveal locations on the screen (for details, see Chartrand and Bargh, 1996). Intervals between pictures varied from 2 to 7 seconds. Both the random presentation in one of the four parafoveal regions and the random sequence of time intervals between stimulus presentations ensured that it was impossible for participants to learn or predict the next presentation of the stimuli.

Results [1]

Self-evaluation

First of all, we analyzed the item 'inferior' to check whether the subliminal primes had influenced participants' self-evaluations, which in turn could be responsible for differences in jealousy scores. However, an independent t-test showed that this was not the case. Women exposed to the attractive rival reported equal amounts of inferiority as women exposed to the unattractive rival: M = 2.21 and M = 2.29, t (38) = -.17, *ns*. Thus, we concluded that participants' self-evaluations were not affected by the subliminal priming.

Jealousy slider

Next, an independent samples t-test was conducted with the jealousy slider as the dependent variable. This analysis showed that women who were exposed to the attractive rival reported significantly more jealousy than women who were exposed to the unattractive rival: M = 77.24 and M = 64.50 respectively, t (38) = 1.99, $p < .05$.

Multiple adjective rating scale

First of all, an independent-samples t-test was conducted with the sum of the 11 adjectives (suspicious, betrayed, worried, distrustful, jealous, rejected, hurt, anxious, angry, threatened, and sad). This analysis showed that women who were subliminally exposed to the attractive rival also reported significantly more jealousy ($\sum$ = 34.00) than women who were subliminally exposed to the unattractive rival ($\sum$ = 27.81), t (38) = 2.00, $p < .05$.

Next, we looked at the adjectives individually. No significant difference between women exposed to the attractive rival and women exposed to the unattractive rival emerged for the adjectives suspicious, betrayed, distrustful, rejected, anxious, and threatened (t's < 1.57, *p's* > .06). Independent samples t-tests showed that women exposed to the attractive rival reported more *jealousy* when it was measured with the adjective (M = 4.11) than women exposed to the unattractive rival (M = 3.33): t (38) = 2.49, $p < .05$. Moreover, the attractive rival also caused women to feel more *worried* (M = 3.47, t (38) = 2.39, $p' < .01$)

[1] Since we have strong directional predictions – i.e. we expect women to report more jealousy, worry, anger, and sadness after exposure to an attractive rival – we report one-tailed tests here.

than the unattractive rival did (M = 2.67). In addition, women exposed to the attractive rival also reported feeling more *hurt* (M = 3.16) than women exposed to the unattractive rival (M = 2.57), t (38) = 1.73, $p < .05$. Women exposed to the attractive prime also reported being more *angry* (M = 3.32) than women exposed to the unattractive rival: M = 2.52, t (38) = 2.04, $p < .05$. Finally, women exposed to the attractive rival also reported significantly more *sadness* (M = 3.05) than women exposed to the unattractive rival: M = 2.33, t (38) = 1.95, $p < .05$. For an overview of all results, see table 1.

Table 1. Means for women after subliminal exposure to a rival with an attractive face or a rival with an unattractive face (study 5.2).

	Mean	SD	t	p
Jealousy slider				
Attractive rival	77.24	12.21	1.99	<.05
Unattractive rival	64.50	25.34		
Inferior				
Attractive rival	2.21	1.40	-.17	*ns*
Unattractive rival	2.29	1.42		
Multiple Adjective Scale				
Attractive rival	34.00	7.81	2.00	<.05
Unattractive rival	27.81	11.27		
Jealous				
Attractive rival	4.11	.81	2.49	<.01
Unattractive rival	3.33	1.11		
Worried				
Attractive rival	3.47	.96	2.39	<.05
Unattractive rival	2.67	1.16		
Hurt				
Attractive rival	3.16	.90	1.73	<.05
Unattractive rival	2.57	1.21		
Angry				
Attractive rival	3.32	1.16	2.04	<.05
Unattractive rival	2.52	1.29		
Sad				
Attractive rival	3.05	.97	1.95	<.05
Unattractive rival	2.33	1.32		

General discussion

Facial attractiveness is an important mate selection criterion for men, as well as a characteristic that women use to evaluate – and derogate – their sexual rivals. In view of the importance of rival evaluation for one's reproductive success and the centrality of facial attractiveness in women's rival evaluation (see for example Dijkstra & Buunk, 1998), in the present chapter we assumed that during the course of human evolution, facial attractiveness as a cue to one's rival's mate value may have evolved to become perceived even outside conscious awareness. Indeed, our findings clearly suggest that jealousy is evoked in women even when they are subliminally exposed to another woman with an attractive face. That is, our results show that women reported significantly more jealousy (as measured by both the jealousy slider and the multiple adjective rating scale) after subliminal exposure to the attractive rival than after exposure to the unattractive rival. This is in line with previous research (Dijkstra & Buunk, 1998), in which women who were consciously exposed to photographs of an attractive woman also reported they would feel more jealousy than women exposed to a photograph of an unattractive woman. Our research takes these studies one step further: in our experiment women's jealousy was evoked outside participants' conscious awareness through very brief exposure to a picture of a rival. Thus, it seems facial attractiveness is such a salient cue to a woman's mate value and thus her possible threat as a rival, that it can be detected and be jealousy-evoking outside conscious awareness. Moreover, significant differences between the reactions to an attractive and an unattractive rival were also found on other emotions. Women who were exposed to the rival with the attractive face reported they would feel more worried, angry, hurt, and sad if the situation described in the scenario would happen to them. Again, this is in line with previous research (Dijkstra & Buunk, 1998) in which it was found that attractive rivals caused more anxiety and feelings of threat than unattractive rivals.

Our findings suggest that participants have unconsciously linked a photograph of either an attractive or an unattractive woman to a third person, which in turn has lead to 'projecting' these characteristics onto the rival – who was described without any characteristics in the scenario. We hypothesize therefore that our results are not due to

mere social comparison with the subliminally presented targets. If social comparison had taken place, we would expect to find a difference between conditions on the item 'inferior', with participants who had been exposed to the attractive rival reporting feeling more inferior than participants who had been exposed to the unattractive rival. A study by Stapel and Blanton (2004) on subliminal social comparison effects has shown that after subliminal exposure to either an attractive or an unattractive face, women's implicit self-esteem was affected. That is, their signature size - a measure of implicit self-esteem (Zweigenhaft, 1977) – was smaller when they had been subliminally primed with an extremely attractive face than when they had been primed with an extremely unattractive face. However, in the current study we found no difference between conditions on the item 'inferior', which suggests that the results reported here were not influenced by participants' self-evaluations, but can be attributed to the subliminal primes. Having said this, in future studies a measure of self-rated attractiveness should be included, since even though the subliminal primes did not influence participants' self-worth, they could have had an influence on women's ratings of their own attractiveness.

Conclusion

In conclusion, the results from the present chapter add to the literature on the effects of a rival's facial attractiveness on jealousy by showing that attractive rivals evoke more jealousy than unattractive rivals, even when one is unconsciously exposed to them. Moreover, the present research adds to the literature on unconscious evocation of jealousy by showing that not only words (Massar et al., 2008) and line drawings of body shapes (Massar & Buunk, 2009) are able to evoke participants' jealousy outside conscious awareness, but also rivals who are presented in the form of photographs also have an impact on participants' emotions. In our opinion, the present research again illustrates that the use of paradigms from social cognition may offer many opportunities for testing hypotheses generated from an evolutionary psychological point of view.

Chapter 6

Clothes make the man

Subliminal priming with high and low status rivals

Clothes make the man. Naked people have little or no influence on society.
- Mark Twain

Given the importance of pair bonding to human reproductive success, and given the costs one incurs when a mate refrains from the relationship, it is to be expected that humans will expend considerable effort to retain their partners. For human males there is always a risk of being cuckolded by his partner – that is, the risk that he will invest resources in offspring genetically unrelated to him. Male jealousy is hypothesized to have evolved as an anti-cuckoldry adaptation and to function primarily to prevent a mate's (sexual) infidelity (Buss et al., 1992; Daly et al., 1982). Female jealousy on the other hand is hypothesized to prevent emotional infidelity, since a mate who abandons the relationship and divert his time, resources and commitment to a rival woman and her offspring is most threatening to a woman's reproductive success (Buss et al., 1992). To solve the adaptive problem of fending off intrasexual competition and preventing one's mate's infidelity, men and women have a number of mate guarding behaviors to their disposal. Previous research (Buss & Shackelford, 1997; Daly et al., 1982) has shown that male mate guarding behaviors range from tracking a partner's whereabouts to preventing a mate from spending time with individuals of the opposite sex. Buunk (1997) calls this type of mate guarding possessive jealousy, and designed a questionnaire to measure individual differences in the degree to which one is inclined to prevent even innocent, superficial contact between one's partner and members of the opposite sex. In the present chapter, that focuses on male jealousy, this questionnaire was included in Study 6.2 to examine the influence of this kind of mate guarding on the effect a rival has on jealousy. It is expected that males who score high on this measure will report higher levels of jealousy after being exposed to a rival, but especially when the rival has a high status – i.e. we expect a moderating influence of possessive jealousy on the relationship between threatening rival characteristics and possessive jealousy.

Male status

In the same way that physical attractiveness is considered to be central to a woman's mate value, status adds to a man's value as a (long-term) partner. Multiple studies (e.g. Buss, 1989; Geary, 2000) have shown that a man's mate value is determined largely by his social status, or by characteristics that point to his ability to acquire status in the future. Indeed, in modern-day America, males with higher incomes report greater frequency of sex and have more biological children (Hopcroft, 2006). Women's preferences for high status men are assumed to reflect a desire for a mate who can provide them and their offspring with sufficient resources (Buss, 1989; Kenrick et al., 1990). A classic study by Townsend and Levy (1990a) shows that women's willingness to enter a relationship with a man is determined more by his socio-economic status than by his level of physical attractiveness. Indeed, when judging male models with differing levels of physical attractiveness and social status, females thought the unattractive but high status model was a more desirable mate than the attractive but medium status model. In a second study, these same authors (Townsend & Levy, 1990b) showed that a man's clothes can be an indicator of a man's status. In this study, women rated men of varying levels of attractiveness who were either wearing the costume of a Burger King employee, or a high-class business suit and a Rolex watch. The results showed that women preferred the high status model, irrespective of his attractiveness, for all levels of relations (ranging from having coffee with someone to marrying him). However, women's clothing style, and thus status, had no impact on men's desire to enter a (sexual) relationship with them. Thus, it seems Mark Twain was right after all: Clothes do make the man – but not the woman.

The findings from the research reported above suggest that high-income, high status men not only are desirable mates for women, but would also make formidable rivals to other men. This assumption has been confirmed in several studies (Massar et al., 2008; Dijkstra & Buunk, 2002, 1998), which show that a rival's status and social dominance are the characteristics that evoke most jealousy in men. In the study by Dijkstra and Buunk (2002) mentioned above, male college students responded with significantly more jealousy than women to rival characteristics like 'has more authority', 'is more assertive' and 'earns more money'(Dijkstra & Buunk, 2002). In light of the centrality of the jealousy-evoking effect of a rival's status and social dominance for men, we decided to focus on these aspects

in our next study. We suggest that without one's conscious awareness of the presence of a rival, mere exposure to high status rivals will be sufficient to trigger jealous feelings in men. Since male status in the Townsend and Levy (1990b) study was successfully manipulated using different clothing styles, we decided to adopt a similar manipulation for the present study. We exposed men and women subliminally to a photograph of a rival wearing either high-status clothes (e.g. a business suit) or low-status clothes (e.g. a maid's uniform or a builder's costume). However, to prevent any confounding effects of facial attractiveness, the heads of the individuals in the pictures will be removed. We predicted that, overall; men will react with more jealousy after being exposed to the high-status rival than after being exposed to the low-status rival, whereas we did not expect a rival's status to affect women's jealousy.

The current research

In the present chapter we first of all describe a study in which the stimuli used in our subliminal priming experiment were pre-tested (Study 6.1). Next, we describe a subliminal priming experiment (Study 6.2) in which Buunk's (1997) measure of possessive jealousy was also included. In this study, we first of all expect a main effect for possessive jealousy, i.e. we expect participants with a high possessive jealousy score to report more jealousy than participants with a low possessive jealousy score. Furthermore, we expect a moderating influence of possessive jealousy on the effect a rival has on participants' jealousy. More specifically, we expect that men with a strong tendency to keep their partners away from people of the opposite sex (i.e. men who have a high possessive jealousy score) will react with more jealousy after subliminal exposure to a high status rival than after exposure to a low status rival. Although we do not expect any effect of a rival's status on women's jealousy scores, we do expect to find an effect of possessive jealousy on female participants' jealous reactions after exposure to a rival. Since participants who have a high possessive jealousy score are hypothesized to react with more jealousy to *any* rival, in the present experiment we expect a main effect of possessive jealousy for women, independent of the rival they are exposed to. In addition to measuring participants' jealousy with the jealousy slider, for exploratory purposes we will assess jealousy related emotions

(threat and anger) that in previous research have been found to be related to jealousy, specifically for men.

Study 6.1

Method

Participants

Five men and fifteen women (mean age = 21.75) from the University of Groningen participated voluntarily in this study.

Materials and procedure

Four pictures were downloaded from the internet: two photographs of males in either a blue-collar outfit or a business suit, and two photographs of women in either a cleaner's outfit or a business suit. To prevent any confounding effects of facial attractiveness, the heads of the individuals in the pictures were removed so the focus would be on their clothes. Body posture and body size was similar for both the high status and the low status pictures.

After filling in general questions such as sex, age and relationship status, participants evaluated the four stimulus photographs. Participants evaluated the low status male, the low status female, the high status male and the low status female respectively. They consecutively indicated for each picture on a seven-point Likert-type scale ([1] = not at all, [7] = very much) how attractive, dominant, and old they thought the person in the picture was, and how high their status was. We also asked how threatened participants would feel if the person in the picture would flirt with their partner. However, this question was not answered by females when evaluating the male pictures and the males did not answer this question when evaluating the female pictures.

Results and discussion

Male stimuli

A repeated measures ANOVA on the characteristic *attractiveness* with the status of the target as the within-subjects factor and participant sex as the between-subjects factor revealed a main effect of the factor: Participants indicated they thought the individual in the high status male picture was significantly more attractive than the individual in the low status male condition: $F(1,18) = 39.72$, $p < .001$, $\eta^2 = .69$; **M** = 5.10 and **M** = 2.90 respectively. There was also a main effect of participant sex: women considered both pictures to be more attractive than men did: $F(1,18) = 5.63$, $p < .05$, $\eta^2 = .24$, **M** = 4.34 and **M** = 3.00 respectively. There was no interaction between participant sex and the factor ($F(1,18) = .16$, *ns*).

A repeated measures ANOVA on the characteristic *dominant* with the status of the target as the within-subjects factor and participant sex as the between-subjects factor revealed a main effect of the factor: Participants indicated they thought the individual in the high status male picture was significantly more dominant than the individual in the low status male condition: $F(1,18) = 9.75$, $p < .01$, $\eta^2 = .35$; **M** = 4.55 and **M** = 3.40 respectively. There was a main effect of participant sex, with women judging both photographs as more dominant than men: **M** = 4.27 and **M** = 3.10 respectively, $F(1,18) = 7.00$, $p < .05$, $\eta^2 = .28$. Again, there was no interaction between the within-subjects factor and participant sex ($F(1,18) = .18$, *ns*).

A repeated measures ANOVA on the characteristic *status* with the status of the target as the within-subjects factor and participant sex as the between-subjects factor revealed only a main effect of the factor. The high status male photograph was judged higher in status than the low status male photograph: **M** = 4.70 and **M** = 2.65 respectively, $F(1,18) = 17.41$, $p < .01$, $\eta^2 = .49$. There was no main effect of participant sex; men (**M** = 3.30) and women (**M** = 3.80) did not differ in their judgment of the status of the males depicted in both photographs: $F(1,18) = 2.52$, *ns*. There was no interaction between the within-subjects factor and participant sex ($F(1,18) = 1.00$, *ns*).

Finally, the male participants were asked to judge how *threatened* they would feel if the person in the photograph would flirt with their partner. Although the N was very small

(N = 5), a paired samples t-test revealed that males would be significantly more threatened by the high status male's flirtations (M = 3.60) than by the low status male's flirtations (M = 1.80): t (4) = -3.67, p <. 05.

From these analyses we concluded that the stimuli were suitable for our subliminal priming experiment. They were rated significantly differently in both status and dominance. Moreover, as was expected based on results of previous studies (e.g. this dissertation; Dijkstra & Buunk, 1998, 2002) male participants judged the high status male to be more of a threat to their relationship than the low status male.

Unfortunately, but not unexpectedly, the attractiveness of both stimuli was not judged to be equal: the high status male was judged more attractive by both male and female participants. This can be explained by the fact that for men, attractiveness and status are highly correlated. A meta-analysis that examined findings of the experimental literature on the physical-attractiveness stereotype showed that physically attractive people are perceived as more dominant, sexually warm, mentally healthy, and intelligent than physically unattractive people (Feingold, 1992). Moreover, in research by Dijkstra and Buunk (1998) on rival characteristics and jealousy, the physically attractive rival was not only perceived as more physically attractive but also as more assertive, self-confident, extroverted, and influential than the physically unattractive rival. Thus, it appears that it would be very difficult to control for a stimulus' attractiveness when manipulating dominance.

Female stimuli

A repeated measures ANOVA on the characteristic *attractiveness* with the status of the target as the within-subjects factor and participant sex as the between-subjects factor revealed a main effect of the factor: Participants indicated they thought the individual in the high status female picture was significantly more attractive than the individual in the low status female condition: F(1,18) = 57.25, p < .001, η^2 = .76; M = 3.80 and M = 2.25 respectively. There was no main effect of participant sex: F(1,18) = .006, *ns.* There was however an interaction between participant sex and the factor: F(1,18) = 15.71, p <.01, η^2= .47.

A repeated measures ANOVA on the characteristic *dominant* with the status of the target as the within-subjects factor and participant sex as the between-subjects factor revealed only a main effect of the factor: Participants indicated they thought the individual in the high status female picture was significantly more dominant than the individual in the low status female condition: $F(1,18) = 11.48$, $p < .01$, $\eta^2 = .39$; M = 3.85 and M = 2.60 respectively. There was no main effect of participant sex ($F(1,18) = 1.26$, *ns*) nor a significant interaction between the within-subjects factor and participant sex ($F(1,18) = .1.88$, *ns*).

A repeated measures ANOVA on the characteristic *status* with the status of the target as the within-subjects factor and participant sex as the between-subjects factor revealed only a main effect of the factor. The high status female photograph was judged higher in status than the low status female photograph: M = 4.30 and M = 2.30 respectively, F (1,18) = 35.18, p < .001, $\eta^2 = .66$. There was no main effect of participant sex. Men (M = 3.00) and women (M = 3.40) did not differ in their judgment of the status of the females depicted in both photographs: $F(1,18) = 1.64$, *ns*. There was no interaction between the within-subjects factor and participant sex ($F(1,18) = .55$, *ns*).

Finally, the female participants were asked to judge how threatened they would feel if the person in the photograph would flirt with their partner. A paired samples t-test revealed that females would be significantly more threatened by the high status female's flirtations (M = 3.93) than by the low status female's flirtations (M = 2.07; $t(14) = -5.14$, $p <$ .001.

From these analyses we concluded that the stimuli were suitable for our subliminal priming experiment. They were rated significantly differently in both status and dominance, although, as with the male stimuli, the high status female was judged to be more attractive than the low status female.

Study 6.2

Method

Participants and design

All stimuli and procedures were approved by the Ethical Committee of Psychology of the University of Groningen. Fifty-four men (mean age = 21.61 years, SD = 3.47) and 71 women (mean age = 20.72, SD = 1.86) at the University of Groningen took part in this study and received course credit for their participation. They were randomly assigned to either the high status prime condition or the low status prime condition.

Materials and procedure

After answering general questions (age, sex, educational level etc.) and before starting with the subliminal priming task, participants filled in the Possessive Jealousy scale (Buunk, 1997). Participants rated on a 5-point scale (1 = *not applicable at all*, 5 = *very much applicable*) how much each of the following items applied to them: 'I don't want my partner to meet too many people of the opposite sex', 'It is not acceptable to me if my partner sees people of the opposite sex on a friendly basis', 'I demand from my partner that he/she does not look at other women/men', 'I am quite possessive with respect to my partner', and 'I find it hard to let my partner go his/her own way'. Men and women reported equal intensities (t (123) = -.89, *ns*) of possessive jealousy: M = 1.85, SD = .81 versus M = 1.98, SD = .81. Reliability for this scale was very good and could not be raised by omitting an item: α = .86.

Next, participants completed the parafoveal priming task. This task was identical to the one used in Study 6.1 (this chapter), except for the priming stimuli. The stimuli used in the present study were downloaded from the internet and consisted of, for males, a man wearing in a workers' costume (the low status prime) and a man dressed in a business suit (the high status prime). For women, there was a woman dressed in a cleaner's uniform (the low status prime) and a woman dressed in a business suit (the high status prime). We removed the heads of these men and women so the focus would be on their clothes. All stimuli were pre-rated (see Study 5.3, this chapter) and were considered to be sufficiently different in status and dominance.

The priming stimuli were flashed in 15 of the 60 experimental trials. In the practice trials and in the remainder of the 45 experimental trials participants were exposed to geometrical shapes (circles, triangles and squares), which also were presented for 60 ms. These shapes were of the same size as the priming stimuli and consisted of black line drawings on a white background.

After completing the parafoveal priming task, participants read a shortened version of the scenario developed by Dijkstra and Buunk (1998). Participants were told to visualize the situation described in the vignette before continuing with the experiment. The male version reads as follows:

You are at a party with your girlfriend and you see an unfamiliar man walk up to her. He starts flirting with her. She seems to like it, and starts flirting back.

The next part of the experiment consisted of the jealousy slider, on which participants could indicate how jealous they would feel if the situation described in the scenario would happen to them. The slider had endpoints 0 (*not jealous at all*) and 100 (*extremely jealous*). Participants could use the mouse to slide a knob to the position on the scale that best indicated their feelings. Moreover, participants rated how jealous, threatened, and angry they would be if the situation described in the scenario would happen to them. These adjectives were rated on a five-point scale with 1 = *not at all* and 5 = *very strong*.

Finally, participants' awareness of the subliminal primes was assessed. In a funneled debriefing procedure (Bargh et al., 1996) they were asked what they thought the purpose of the study was, whether they thought any tasks in the study were related, whether anything in the study seemed strange or suspicious to them, and what they thought the content of the flashes had been. Participants indicated they had they had only seen the two neutral words on the screen and had not been aware of the purpose of the study or the content of the flashes.

Results

Jealousy slider

A regression analysis with participant sex (male vs. female), prime (high vs low status) and possessive jealousy (standardized) as predictors, and the jealousy slider as the dependent variable was conducted. All two-way and three-way interactions were included in the analysis (N = 125). The overall model was significant: $R^2 = .29$, $F(7,117) = 6.73$, $p < .001$. There were no main effects of participant sex or prime (Bs < 1.71, ts < 1.14, *ns*). As predicted, there was a main effect of possessive jealousy, $B = 9.40$, $t(117) = 6.11$, $p < .001$. No other two-way interactions were significant, but there was a significant three-way interaction between participant sex, prime and possessive jealousy: $B = -3.95$, $t(117) = -2.57$, $p = .01$.

To interpret the three-way interaction, simple effect analyses were performed. These showed that men high and low in possessive jealousy who were exposed to the high status rival did not differ in their jealousy: M = 75.73 and M = 71.11 respectively, $B = 2.31$, $t(117) = .81$, *ns*. However, when they were exposed to a low status rival, men high and low in possessive jealousy did differ in their jealousy. Men high in possessive jealousy reported significantly more jealousy (M = 93.01) than men low in possessive jealousy (M = 65.28): B = 13.87, t (117) = 3.7 0, p < .001. For an illustration of these effects, see Figure 1. Among women, there was no difference between the responses to the low and the high status rival. The only effect found among women was that of possessive jealousy. When exposed to a high status rival, women high and low in possessive jealousy reported significantly different levels of jealousy: M = 84.74 and M = 59.07 respectively, $B = 12.83$, $t(117) = 4.77$, $p < .001$. This same pattern of results was found for women exposed to a low status rival: women high in possessive jealousy reported significantly more jealousy than women low in possessive jealousy: M = 81.59 and M = 64.43 respectively, $B = 8.58$, $t(117) = 2.94$, $p < .01$ (see Figure 2).

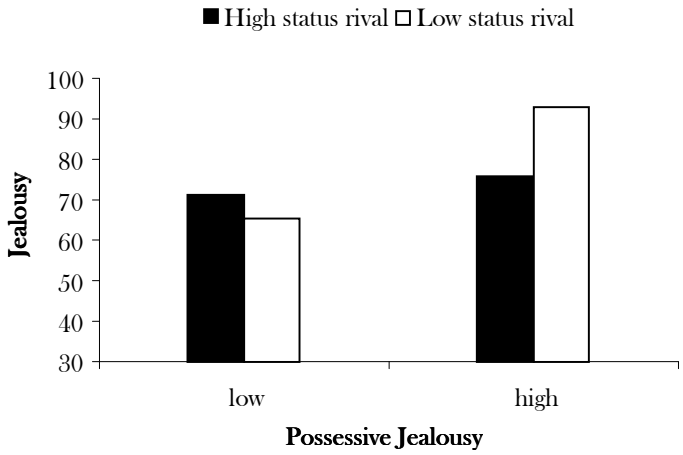

Figure 1. Jealousy scores for men high and low in possessive jealousy after subliminal priming with a high status or low status rival.

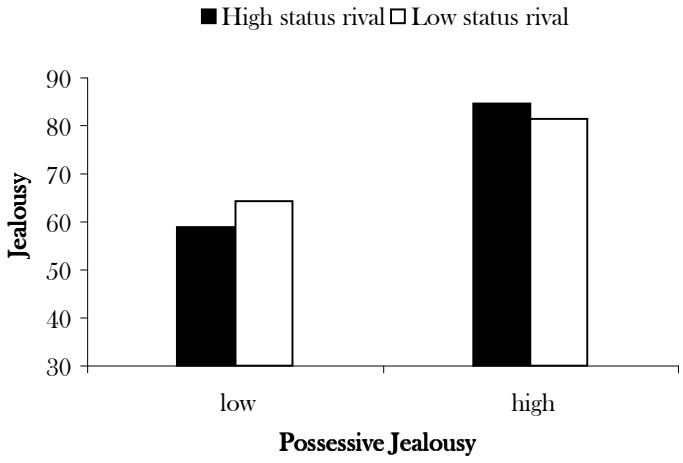

Figure 2. Jealousy scores for women high and low in possessive jealousy after subliminal priming with a high status or low status rival.

Adjectives

Jealous. A regression analysis with participant sex (male vs. female), prime (high vs low status) and possessive jealousy (standardized) as predictors, and the adjective 'jealous' as the dependent variable was conducted. All two-way and three-way interactions were included in the analysis (N = 125). The overall model was significant: $R^2 = .38$, $F(7,117) = 10.35$, $p < .001$. There were no main effects of participant sex or prime (Bs < -.08, ts < -.99, *ns*), but there was a main effect of possessive jealousy: $B = .65$, $t(117) = 7.67$, $p < .001$. There was a significant two-way interaction between prime and possessive jealousy: $B = -.26$, $t(117) = -2.78$, $p < .01$. No other two-way interactions were significant, but there was a highly significant three-way interaction between participant sex, rival characteristics and possessive jealousy: $B = -.24$, $t(117) = -2.81$, $p < .01$.

To interpret the three-way interaction, simple effect analyses were performed. The results were similar to those for the jealousy slider. That is, men high and low in possessive jealousy who were exposed to the high status rival did not differ in their jealousy: M = 3.57 and M = 3.26 respectively, $B = .15$, $t(117) = .97$, *ns*. However, men high and low in possessive jealousy did differ in jealousy when they were exposed to a low status rival. Men high in possessive jealousy reported significantly more jealousy (M = 4.84) than men low in possessive jealousy (M = 2.64): $B = 1.10$, $t(117) = 5.32$, $p < .001$. When exposed to a high status rival, women high and low in possessive jealousy reported significantly different levels of jealousy: M = 4.47 and M = 3.12 respectively, $B = .68$, $t(117) = 4.57$, $p < .001$. The same pattern of results was also found for women exposed to a low status rival: women high in possessive jealousy reported significantly more jealousy than women low in possessive jealousy: M = 4.36 and M = 3.01 respectively, $B = .67$, $t(117) = 4.20$, $p < .001$. For an overview of all means, see Table 1.

Table 1. Mean scores for men and women high and low in possessive jealousy on the adjectives jealous, threatened and angry (Study 5.4) after priming with a high status or low status rival.

	Men		*Women*	
Possessive jealousy	High	Low	High	Low
Jealous				
High status rival	3.57	3.26	4.47	3.12
Low status rival	4.84	2.64	4.36	3.01
Threatened				
High status rival	2.66	2.32	3.25	2.54
Low status rival	3.92	2.23	2.85	2.69
Angry				
High status rival	2.61	3.07	3.89	2.63
Low status rival	3.82	2.31	3.85	2.69

Threatened. A regression analysis with participant sex (male vs. female), prime (high vs low status) and possessive jealousy (standardized) as predictors, and the adjective 'threatened' as the dependent variable was conducted. All two-way and three-way interactions were included in the analysis (N = 125). The overall model was significant: $R^2 = .17$, $F(7,117) = 3.47$, $p < .01$. There were no main effects of participant sex or prime (Bs < -.02, ts < -.27, *ns*). As predicted, there was a main effect of possessive jealousy, $B = .36$, $t(117) = 3.91$, $p < .001$. The interaction between participant sex and prime was significant: $B = -.18$ $t(117) = -1.97$, $p = .05$. The other two-way interactions were not significant, but there was a significant three-way interaction between participant sex, rival characteristics and possessive jealousy: $B = -.24$, $t(117) = -2.57$, $p = .01$.

To interpret the three-way interaction, simple effect analyses were performed. These showed that men high and low in possessive jealousy who were exposed to the high status rival did not differ in their feelings of being threatened: M = 2.66 and M = 2.32 respectively, $B = .17$, $t(117) = .97$, *ns*. However, men high and low in possessive jealousy did differ in jealousy when they were exposed to a low status rival. Men high in possessive jealousy reported significantly more jealousy (M = 3.92) than men low in possessive jealousy (M = 2.23): B = .85, t (117) = 3.74, p < .001. When exposed to a high status rival,

women high and low in possessive jealousy reported significantly different levels of threat: M = 3.25 and M = 2.54 respectively, $B = .36$, $t(117) = 2.21$, $p < .05$. However, women high and low in possessive jealousy reported equal levels of threat after exposure to a low status rival: M = 2.85 and M = 2.69 respectively, $B = .08$, $t(117) = .46$, *ns*. See table 1 for an overview of all means.

Angry. A regression analysis with participant sex (male vs. female), prime (high vs low status) and possessive jealousy (standardized) as predictors, and the adjective 'angry' as the dependent variable was conducted. All two-way and three-way interactions were included in the analysis (N = 125). The overall model was significant: $R^2 = .21$, $F(7,117) = 4.48$, $p < .001$. There were no main effects of prime or participant sex (B's < -.06, t's < -.54, *ns*). There was a main effect of possessive jealousy, $B = .43$, $t(117) = 3.39$, $p < .001$. The interaction between prime and possessive jealousy was significant: $B = -.23$, $t(117) = -2.12$, $p < .05$. The other two-way interactions were not significant, but there was a significant three-way interaction between participant sex, rival characteristics and possessive jealousy: $B = -.26$, $t(117) = -2.36$, $p < .05$.

To interpret the three-way interaction, simple effect analyses were performed. These showed that men high and low in possessive jealousy who were exposed to the high status rival did not differ in their anger: M = 2.61 and M = 3.07 respectively, $B = -.23$, $t(117) = -1.14$, *ns*. Men high and low in possessive jealousy did differ in anger when they were exposed to a low status rival, however. Men high in possessive jealousy reported significantly more anger (M = 3.82) than men low in possessive jealousy (M = 2.31): B = .76, t (117) = 2.82, p < .01. Women high and low in possessive jealousy reported significantly different levels of anger when exposed to a high status rival: M = 3.89 and M = 2.63 respectively, $B = .63$, $t(117) = 3.27$, $p < .01$. This same pattern of results was found for women exposed to a low status rival: women high in possessive jealousy reported significantly more anger than women low in possessive jealousy: M = 3.85 and M = 2.69 respectively, $B = .58$, $t(117) = 2.77$, $p < .01$. See table 1 for an overview of all means.

Discussion

In Study 6.2, we subliminally primed participants with photographs of men and women wearing either high status clothing or low status clothing. To prevent confounds with attractiveness, the faces of the stimuli pictures were removed. As predicted, women were not affected by their rival's status – we did not find any significant results of the subliminal primes for women. However, we did find the expected main effect of possessive jealousy for women, with women scoring high on this measure indicating more jealousy, feelings of threat and anger than women who were low in possessive jealousy. Thus, we conclude that, as would be expected, women who often engage in (extreme) mate guarding, also experience more negative feelings following a jealousy evoking situation.

For men, the results tell a different story. Although there was no main effect of our experimental primes, possessive jealousy had a moderating effect on men's jealousy after exposure to a high or a low status rival. Surprisingly, and contrary to our expectations, men high in possessive jealousy reacted with most jealousy to a *low status* rival. Since this pattern of results was found not only for our main dependent variable but also for the adjectives jealous, threatened, and angry, we can assume it is a robust pattern. But since the literature on rivals and jealousy so far has consistently found that men are most jealous and threatened when their rival is high in status and social dominance (e.g. Dijkstra & Buunk, 1998, 2002), this pattern of results raises a question. Why would men who are possessively jealous become most jealous when they are confronted with a rival who is low in status?

The most straightforward explanation of our results is that although the stimuli were pre-rated on 'dominance' (see Study 6.1, this chapter), with the high status male scoring higher on this construct, in this case dominance could have been primarily interpreted as social dominance by our raters, whereas in the subliminal priming the biggest influence was exerted by the primes' physical dominance and muscularity. Thus, although previous research (Dijkstra & Buunk, 1998, 2002) has repeatedly found that men reported more jealousy after a confrontation with a rival possessing characteristics indicative of high status and social dominance, it is very well possible that physical features have a bigger impact on one's jealousy when exposure to a rival is of very short duration. Moreover, for women,

there are reproductive benefits of mating with muscular, physically dominant men, the most documented one being securing access to superior ('good') genes (Gangestad & Simpson, 2000). Indeed, recent research by Frederick and Haselton (2007) showed that muscular men reported having more short-term partners, and reported having more partners who were already mated to someone else. Moreover, the women in these studies indicated that their short-term partners were more muscular than their other sex partners, and that they waited for a shorter period of time before having sex with them (1 week vs. 12 weeks). Thus, it is reasonable to assume that men exhibiting cues to good genes, i.e. muscular, physically dominant men, would represent formidable rivals to other men. Since exposure to the rival in our paradigm is of extremely short duration, it is possible the participants in Study 6.2 only judged the general outline of the rival. It is possible that the low status rival is considered to be more muscular and physically dominant than the high status male. Thus, if the low status rival in the present experiment was indeed judged to be higher in physical dominance – and thus representative of a 'good-genes' man – than the high status rival, it is understandable that men were threatened by him more than by the high status man. Future studies should examine this possibility and have stimuli rated for both physical and social dominance.

Another explanation of our results centers on the characteristics of highly possessively jealous individuals. Possessive jealousy can be considered as a form of intrasexual competition which expresses itself in an extreme form of mate guarding, such as tracking the whereabouts of one's partner and keeping him or her away from the opposite sex (Buunk, 1997; Buss & Shackelford, 1997). Individuals scoring high on this measure tend to become jealous about *any* contacts of their partner with members of the opposite sex, which is why they engage in heavy mate-guarding. One should therefore expect this measure to be associated with questionnaires measuring intrasexual competition. Indeed, in the present study a measure of intrasexual competition (Buunk & Fisher, in press) was included as part of another study, and correlational analyses show that possessive jealousy is positively associated with intrasexual competition: $r = .35$, $p < .001$. Jealousy in individuals who are possessively jealous of their mates would of course arise by their partner's contacts with highly attractive, high status males. But, as one can imagine, it would be even more devastating to one's self-esteem if one's partner is flirting with a male who is clearly low in

status. This explanation fits in with results reported by Townsend and Levy (1990a), who reported that low income professionals – i.e. individuals who had a high occupational status but a low income – were rated by women as less desirable partners than low income laborers – i.e. individuals who had a low occupation status and a low income. Extending this result to the present study on jealousy and rivals, we can hypothesize that since low income professionals were rated as less desirable partners, they may also evoke less jealousy in men when presented as rivals – especially when the low income laborer is judged to be higher in physical dominance. However, to fully investigate the effect of a low status rival on participants' self-esteem, future studies should include self-evaluative measures both before and after the priming.

Conclusion

To conclude, in the present chapter we again found clear sex differences in the jealousy evoking effect of rival characteristics. It seems that participants are able to make fast and frugal first impressions of a rival using their social status (Study 6.2) as a cue to determine the threat this person would pose to their relationship. Moreover, we found that one's tendency to engage in possessive mate guarding moderates the relationship between exposure to rivals and subsequent jealousy. We conclude that rivals need not be evaluated consciously for jealousy and a number of other negative emotions to arise – their threat to one's relationship can be assessed literally in the blink of an eye. In our opinion, the present research constitutes a valuable addition to the existing literature on the role of rival characteristics in jealousy.

Chapter 7

General Discussion

Jealousy is omnipresent. In books and journals, on television and in movies, jealousy has proven to be an inspirational topic. When you enter 'jealousy' as a search term in *Google*, in 0.26 seconds 11.300.000 hits appear, and the same search term generates over 2060 results from all areas of psychology in *PsychINFO*. Clearly, jealousy continues to fascinate scores of people, both the layperson and the professional. In this thesis, I have tried to paint my own picture of jealousy, and of whether we need to be aware of our rivals to become jealous. I have argued that although most people view jealousy negatively, it may actually be a very adaptive emotion that functions to protect the pair bond. Although I have found a number of answers to the questions I started out my research with, several questions still remain unanswered. So, after a short summary of the main findings of each chapter, I will present some final thoughts on the implications and limitations of my work.

Summary of main findings

Chapter 2

In this chapter, I first described a study (Study 2.1) in which I replicated some of the results found by Dijkstra & Buunk (1998). Nest, I presented two studies in which I have subliminally primed men and women with words relating to rival characteristics – either attractiveness or social dominance – and investigated several possible moderators on the relationship between exposure to rival characteristics and jealousy. In Study 2.2 I found that women's mate value moderated their jealousy: women with a low self-indicated mate value reported more overall jealousy than women with a high mate value, but these latter women differentiated more between the rival characteristics. More specifically, women with a high mate value indicated more jealousy after exposure to attractiveness words than after exposure to social dominance words. For men, I found that their relationship satisfaction acted as a moderator. Men low in relationship satisfaction reported more overall jealousy, whereas men high in relationship satisfaction indicated they would mostly feel jealous when confronted with a socially dominant rival. In Study 2.3, I reported findings indicating that women's menstrual cycle may be another factor that influences jealousy. Women who were at the time of the experiment in the fertile phase of their menstrual cycle reported more

jealousy after exposure to attractiveness words and a jealousy evoking scenario than women who were not in the fertile phase of their cycle.

Chapter 3

In Chapter 3, I reported a subliminal priming experiment in which again words were used as subliminal primes. This time however, these words were used to activate either a sexual or a commitment context, whereas the evaluation of the rival was the dependent variable. After the subliminal priming, a rival was introduced. Participants indicated how upset they would be if this rival would *outperform* them with regard to a number of characteristics, thereby stressing the intrasexual competition situation. Moreover, a measure of participants' sex drive was included – I argued that sex drive can be regarded as a fundamental correlate of individual differences in mating strategies and that it may modulate men's tendencies to engage in intrasexual competition. I expected that men with a high sex drive would be more threatened by a rival in a sexual context than in a commitment context, whereas men with a low sex drive would be more threatened by a rival in a commitment context. In line with my expectations, men with a high sex drive responded with more upset to the presence of a romantic rival than men with a low sex drive, and especially in the sexual context. However, men with a low sex drive were more threatened by a rival in the commitment context than in the sexual context. Thus, it seems that men, depending on their natural inclination to engage in intrasexual competition, use subtle contextual cues to gauge whether a particular rival is a direct threat to their mating efforts.

Chapter 4

Chapter 4 also focused on subliminal exposure to rival characteristics, but instead of using words, in this chapter I used Singh's (1993a) line drawings depicting men and women with varying waist-to-hip and shoulder-to-hip ratios. WHR and SHR are hypothesized to be indicators of health and fertility in women and men respectively. Research by for example Singh (1993a) has shown that women with an hourglass body shape – i.e. men with a WHR of 0.7 – and men with a body shaped like an inverted 'V' – i.e. men with a SHR of 1.1 – are considered most attractive and are preferred most as mates. In the parafoveal

subliminal priming technique, the primes – in this case the line drawings – are presented to participants outside their conscious visual field (the parafoveal field). In this chapter, the results from two studies showed that both men (Study 3.1) and women (Study 3.2) reported more jealousy after exposure to a line drawing with an attractive body shape than after exposure to a figure with an unattractive body shape. I concluded that body shape is such an important cue to one's mate value, that over the course of evolution, humans have developed the ability to evaluate a rival's physical characteristics outside conscious awareness.

Chapter 5

In Chapter 5, the focus was on the importance of facial attractiveness as a characteristic that largely determines a woman's mate value. As in Chapter 4, a parafoveal subliminal priming paradigm was employed, but this time photographs were used. Female participants were exposed to either an attractive woman or an unattractive woman outside their conscious awareness, after which they read the jealousy-evoking scenario (Study 5.2). The results show that women exposed to the attractive woman reported significantly more jealousy. Moreover, they reported feeling significantly more worried, hurt, angry, and sad than women exposed to the unattractive face. These findings suggest that participants have unconsciously linked a photograph of either an attractive or an unattractive woman to a third person, which in turn has lead to 'projecting' these characteristics onto the rival – who was described without any characteristics in the scenario.

Chapter 6

Using the same parafoveal subliminal priming paradigm as in Chapters 4 and 5, in Chapter 6 we exposed participants to photographs of either a high status rival or a low status rival. To prevent any possible confounding effects of facial attractiveness, and to ensure a focus on our stimuli's status, the faces of the men and women in the photographs used as stimuli were removed. In addition to a focus on status, this chapter also aimed to investigate the influence of individual differences in possessive jealousy (or extreme mate guarding; Buunk, 1997). I predicted a moderating effect of this variable. More specifically, I expected that men scoring high on this measure would report more jealousy than men scoring low

on this measure, but especially after subliminal exposure to the high status rival. For women, only a main effect of possessive jealousy was expected – and found. For men, the results were somewhat surprising. Although the predicted main effect of possessive jealousy was found – i.e. men who scored high on this measure reported more overall jealousy than men who scored low on this measure – contrary to our expectations, men high in possessive jealousy reacted with most jealousy, anger, and feelings of being threatened to a *low status* rival. I reasoned that these results could reflect the fact that the low status rival could have been judged higher in physical dominance and muscularity – and thus so-called 'good genes' – than the high status rival. Although previous research (Dijkstra & Buunk, 1998, 2002) has repeatedly found that men reported more jealousy after a confrontation with a rival possessing characteristics indicative of high status and social dominance, it is very well possible that physical features have a bigger impact on one's jealousy when exposure to a rival is of very short duration.

These findings all seem to suggest that the evaluation of rivals in a romantic jealousy situation is a basic mechanism that may function unconsciously and automatically, and which is affected by factors that are relevant from an evolutionary perspective, such as mate value and fertility of the female. Next, I will discuss the implications of this research, as well as some limitations.

Implications and Limitations

Although some people like to believe that despite their biological differences, men and women are essentially the same, evolutionary psychologists posit that men and women do not only have different bodies, they also have different minds. Men and women make essentially different investments in their offspring, which produces different adaptive problems for men and women (Miller, 2000; Buss, 1994; Trivers, 1972). Differential parental investment not only leads to sex-specific mate preferences, but also has different consequences for intrasexual competition with one's romantic rivals. Previous research (Dijkstra & Buunk, 1998, 2002) did already establish that men's and women's jealousy is

evoked by different rival characteristics. Whereas jealousy in women is evoked more than in men by a rival's physical attractiveness, jealousy in men more than in women is evoked by a rival's status and dominance related features.

In the present dissertation, I have shown that not only explicit exposure to rivals but also exposure to rivals *outside one's conscious awareness* is sufficient to evoke jealousy. Using various kinds of stimulus material, the studies described in this dissertation by and large show the expected sex differences in the characteristics of a rival that evoke jealousy – whether physical attractiveness was defined as general attractiveness (Chapter 2), waist-to-hip ratio (Chapter 4), or facial attractiveness (Chapter 5), and whether status and dominance related features were defined as social dominance (Chapter 2), shoulder-to-hip ratio (Chapter 4), or social status (Chapter 6). Moreover, not only did we find sex differences in self-reported jealousy – measured both by a continuous sliding scale and on a five-point scale – but also on a number of other relevant emotions such as anger, worry, sadness and threat.

Physical Attractiveness versus Social Status

However, although the results I summarized above were overall clear-cut for women – i.e. they consistently reported more jealousy after exposure to (physical) attractive rivals – the results for men were somewhat less consistent. Whereas Dijkstra and Buunk (1998, 2002) repeatedly reported strong jealousy-evoking effects of socially dominant rivals for their male participants, in the current studies the male participants generally seem to respond especially with jealousy to rivals exhibiting signs of physical dominance or physical attractiveness. Thus, this dissertation raises a new question: Is a rival's social dominance central to his ability to evoke a man's jealousy, or is it his physical appearance?

A possible answer to this question could lie in the examination of the experimental methods that were used in the current dissertation and in previous research. In their studies on jealousy and rival evaluations, Dijkstra and Buunk (1998, 2002) made the social dominance of the rival explicit – that is, they presented participants with a personality description in which the socially dominant rival was introduced as very assertive, with good leadership qualities, and the center of attention at parties. In the studies described in the

present thesis, the rival was introduced either in the form of a few words relating to social dominance (Chapter 2, Study 2.2), or in the form of a line drawing (Chapter 4, Study 4.1), or photograph (Chapter 6, Study 6.2), which were all presented for only 17-60 milliseconds and immediately masked by neutral stimuli. Moreover, our experimental design did not permit more elaborate descriptions of the rival's behavior other than what was described in the vignette the participants read after the subliminal priming. Thus, the participants in the studies described in the previous chapters had to form an impression of the rival quickly, and based on little information. Taken together, this could have caused a more global processing of stimuli information which in my opinion is particularly evident in Study 6.2 (Chapter 6), where participants were exposed to photographs of models wearing either high status or low status clothes. In this study, it is possible that processing time was simply too short for participants to take in details like the status information conveyed by the models' costumes, and that rather, it was the general body shape of the models that influenced male jealousy. However, I believe this is not a complete explanation of the results I found.

There are several studies (e.g., Frederick & Haselton, 2007; Gangestad & Simpson, 2000; Barber, 1995; Buss, 1994) that report that besides status and (social) dominance, male physical attractiveness is actually a strong determinant of male mate value – especially when men are evaluated by women for short-term relationships. This research suggests that certain traits of male body structure such as height, shoulder width, and upper-body musculature are sexually attractive to women, and also intimidating to other men. In addition to their attractiveness and intimidating effects, these secondary sexual characteristics also provide cues to a male's hormonal status and phenotypic quality. This is consistent with the 'good genes' model of sexual selection (Gangestad, Garver-Apgar, Simpson, & Cousins, 2007; Gangestad & Simpson, 2000; Thornhill & Gangestad, 1993), which posits that women will value certain traits in men that are assumed to be indicators of genetic fitness, including masculinity, physical attractiveness, muscularity, and symmetry. Indeed, research by Li and Kenrick (2006) has shown that for ideal long-term mates, men prioritized physical attractiveness and women prioritized social status. However, for ideal short-term mates, both sexes prioritized physical attractiveness.

Not only certain physical characteristics – such as a tapered posture – could be interpreted as cues to social dominance and status and thereby indirectly evoke male

jealousy, but a physically attractive male could also have a more *direct* influence on male jealousy. If participants in the studies of the present dissertation have interpreted the jealousy-evoking situation as a short-term mating opportunity for their partners, this would explain why they were more threatened by their rival's physical appearance than by his social status. Mating *context* therefore seems to be a crucial variable that determines what characteristics evoke men's jealousy. Indeed, Gangestad and Simpson (2000) also stress the context dependent nature of human mating psychology and argue that individuals have to make trade-offs between investing in a current long-term relationship and securing multiple short-term mating opportunities. Although for a long time it was thought that only men were concerned with making these trade-offs, the evidence that women also use different mating strategies in different context is piling up (e.g., Frederick & Haselton, 2007; Li & Kenrick, 2006). For example, Buunk and Dijkstra (2004) found that whereas following emotional infidelity, in men a rival's dominance and in women a rival's physical attractiveness evoked jealousy, after *sexual* infidelity it was the rival's physical attractiveness and not his dominance that evoked jealousy in men, whereas the rival's characteristics did not influence women's jealousy in this condition. This finding reflects the importance of physical attractiveness as an attribute for women in the context of casual sexual affairs, and makes it apparent that social dominance and physical attractiveness contribute differently to a rival's mate value - and thus his or her threat – under different conditions. Future studies on the jealousy-evoking effect of a rival's characteristics should in my opinion therefore certainly take the mating context into account.

Is Rival Evaluation Automatic?

The research described in the present thesis started off with the assumption that since rival evaluation and the protection of one's relationship are so crucial to human reproductive success, it is possible that the ability to evaluate rivals has, over the course of human history, evolved to take place outside conscious awareness. To test this assumption, we used several subliminal priming techniques to expose participants to rivals. To make sure the only information the participants received about the rival were the subliminal primes, the rival's appearance and personality characteristics were purposefully withheld in the vignette that was used to introduce the jealousy-evoking situation to participants. In my opinion, the

results from this dissertation clearly show that whether the rival was introduced in the form of words, line drawings or photographs, participants 'projected' the subliminally given information onto the rival described in the vignette. In all our studies, participants were unaware of the purpose of the study, or of the influence of the primes on their performance on subsequent tasks. Thus, our conclusion is that subliminal exposure to a rival sufficed to induce sex-specific jealousy in both male and female participants – rivals were evaluated literally in the blink of an eye. A new question that arises then is whether rival evaluation can be said to arise *automatically* whenever a person of the opposite sex is encountered.

One can assume that highly adaptive responses have evolved to become automatic, since automaticity frees up cognitive resources. This in turn helps the individual respond easily and adaptively to a wide range of physical and social challenges. Bargh (1989) identified four core components of automaticity: Intention, awareness, efficiency, and control. More specifically, a process – or behavior, emotion, attitude, etc. – is deemed to be automatic when there is little intention involved (i.e. it is spontaneous), when it takes place without one being aware of it, when it is highly efficient (i.e. it requires little cognitive capacity), and finally, when it is outside one's control (i.e. it is unconscious). However, not all four features need to co-occur before one can say mental processes are automated (Bargh, 1989). The studies described in the previous chapters can be said to have at least three of the hallmarks of automaticity. First of all, the evaluation of the rival was spontaneous: without the presence of explicit prompts to evaluate the subliminal prime, it had an effect on subsequent emotions, most notably jealousy. Second of all, participants were not aware of the priming, and thus of the presence of the rival. Finally, the information was presented to participants outside their conscious awareness. Moreover, due to the nature of the subliminal priming task, we can assume the rival evaluation was highly efficient – i.e. requiring few cognitive resources – as well. Thus, in the present dissertation it seems that rival evaluation shaped subsequent responses even though participants were not explicitly directed to do so.

In our research, evaluating a rival automatically produced overall the same results as evaluating a rival consciously (e.g., Chapter 2; Dijkstra & Buunk, 1998). Is implicit

evaluation of rivals indeed similar to explicit evaluation? Evidence for a correspondence between explicit and implicit evaluations comes from Gardner, Bargh, Shellman, and Bessenoff (1999, cf. Bargh & Chartrand, 1999). In this study, brain activation patterns of participants making conscious evaluations of stimuli and participants who were merely told to listen to stimuli names – the implicit evaluation condition – were compared. The participants in the latter group did not know they were evaluating, and did not intend to evaluate the stimuli. However, the results showed that in both groups of participants the same area of the brain unique to the evaluative response reacted to the stimuli, suggesting that unintended, unconscious evaluations evoke the same brain activation as explicit evaluations. Thus, in my opinion it is reasonable to assume that in the experiments presented in this thesis, the process of unconscious rival evaluation was comparable to the explicit rival evaluation reported by Dijkstra and Buunk (1998, 2002).

The Importance of Individual Differences

As was detailed above, in the present thesis we have found support for the contention that due to the reproductive costs of losing one's partner, rival evaluation – as part of the larger functionally relevant motive of mate retention – may have developed into an automatic process that is activated whenever a functionally relevant stimulus is encountered. In addition to exploring automaticity in rival evaluation, the present thesis emphasized the role of individual differences in men and women's evaluation of their rival's characteristics. An evolutionary perspective on human behavior is, unfortunately, often seen as implying inflexible, genetically determined processes that operate in an identical fashion across all people, cultures and situations. Besides this being a fundamentally wrong interpretation of evolutionary science, the focus on individual differences within evolutionary psychology is if anything becoming stronger. This is not surprising, since from an evolutionary perspective, individual differences play an important role in determining *how* and *when* adaptive psychological mechanisms are expressed (e.g., Nettle & Clegg, 2008; Figueredo, et al., 2005). Or, as Buss and Greiling (1999) state: "Individual differences [...] rest on a foundation of psychological mechanisms shared by all, but differentially activated in some (p. 221)".

In the present thesis I have examined a number of theoretically relevant individual differences that seem to moderate the influence rival evaluation has on male and female jealousy. More specifically, I have reported how individual differences in female mate value (Chapter 2), male relationship satisfaction (Chapter 2), male sex drive (Chapter 3) and possessive jealousy (Chapter 6) all influence how much jealousy is evoked by a rival possessing certain characteristics. First, these individual differences tend to influence *when* jealousy is evoked by rivals – rivals do not always, and in the same way, evoke one's jealousy. For example, low mate value women tend to feel jealous irrespective of a rival's characteristics, whereas high mate value women only feel jealousy when their rival is high in physical attractiveness (Chapter 2, Study 2.2). Second, individual differences determine *how* rivals affect jealousy – they can determine the interpretation of a jealousy-evoking context and in that sense serve as a 'filter' for the evaluation of the threat the rival poses. For example, in Chapter 3 I showed that individual differences in sex drive determine in which context – a sexual or a commitment context – men feel most challenged by a rival. The study described in that chapter showed that men high in sex drive were challenged most in a sexual context, presumably since they are focused on attracting sexual partners. Men low in sex drive on the other hand are assumed to be focused more on investment in and attention to their current relationship, and these men felt more challenged in a commitment context (see also Gangestad & Simpson, 2000).

Another example of the influence of individual differences on jealousy comes from a recent study reported by Miller and Maner (in press). For years, classic studies (e.g., Schützwohl, 2008; Murphy et al., 2006; Buss et al., 1992) examining the effect of sexual versus emotional infidelity on jealousy typically have found that men report more jealousy after imagining a sexual infidelity of their partner, whereas women report more jealousy after imagining their partner falling in love with a rival. Miller and Maner (in press) reasoned that jealousy in response to different types of infidelity might be grounded in innate, adaptive sex differences, but that they are also likely to be influenced by proximate situational and personality factors. And indeed, these authors found that the typically reported sex differences were exacerbated in individuals who tend to worry about potential relationship threats. To my knowledge, this is the first study to examine the influence of individual differences on the sex difference that is typically reported in these studies.

In my opinion, the focus on individual differences in the current studies and other research on relationship maintenance processes provides a more complete picture of the way men and women's cognitions, emotions and behavior differs when they are confronted with a rival. All in all, I feel evolutionary psychology would benefit from a more rigorous investigation of the influence of individual differences on a number of functionally relevant processes – including, but not limited to, mate choice, mate retention, and mating strategies.

Evolutionary Psychology and Social Cognition

This thesis was written from an evolutionary social psychological point of view – more specifically, from an evolutionary social *cognitive* psychological perspective. Using methods commonly used in social cognition, I have tested hypotheses derived from an evolutionary psychological approach to human behavior. As was already mentioned in the previous chapters, I am not alone in combining these two perspectives. More and more researchers (e.g., Duncan, Park, Faulkner, Neuberg, & Kenrick, 2007; Maner et al., 2003, 2005; Schaller et al., 2003) employ methods commonly used in social cognition to test hypotheses about the way fundamental motives influence human emotions, cognitions, and behavior. In a sense, evolutionary psychology asks the 'Why?' questions, such as why we experience an emotion like jealousy, or why certain rival characteristics are threatening to men but not women. Answers to these questions will most likely emphasize the content of cognitive processing. With a social cognitive approach, I have tried to answer the 'How?' questions, such as how rival evaluation takes place, and how it subsequently influences our emotions. These kinds of questions will generate answers pertaining to the process itself rather than the content.

The research reported in this dissertation is largely in line with Kenrick et al. (2007)'s model of top-down, fundamental motives being activated by bottom-up processes like visual processing. This model presumes that functionally relevant stimuli in the environment are quickly and automatically attended to, especially when a fundamental motive is activated, whereas less relevant features are more likely to be ignored. For example, activation of a mate retention goal will increase attention to goal-relevant stimuli – such as physical attractiveness and social status in same-sex others – and in this way bias

how these stimuli are interpreted and remembered. This model moreover states that as one goal is activated, the processing of stimuli relevant to other goals is inhibited. The results from this dissertation suggest that having been exposed to stimuli *before* a functionally relevant goal is activated produces the same effects as exposing participants to stimuli after a goal is activated (see Maner et al., 2003). That is, the interpretation of stimuli which would on their own not necessarily have been very informative to participants was retrospectively affected by activating a mate retention goal. Thus, "[...] cognitive processing ultimately reflects a mind designed to extract and ponder information prioritized by functional relevance (Kenrick et al., 2007, p. 50)."

In my opinion, the use of paradigms from social cognition offers many opportunities for testing hypotheses generated from an evolutionary psychological point of view. At the same time, by using tested methods to get access to the cognitive processes taking place when a fundamental motive is activated, it is possible to battle some of the criticism still surrounding evolutionary psychology, e.g. that hypotheses generated from an evolutionary point of view are 'just-so stories'.

Conclusion

Emotional states act as signals that specific kinds of agonistic or avoidant behaviors would be functional in the current situation. This is true for so-called 'basic' emotions like fear – causing the individual to flee – or anger – causing the individual to fight – but certainly for jealousy as well. In general, jealousy can be conceptualized as one part of a coordinated system of cognitive, affective, physiological and behavioral responses aimed at guarding one's mate from potential intrasexual competitors which, ultimately, is of importance to reproductive success (Maner & Shackelford, 2007; Buunk et al., 2007; Buss, 1994; Daly et al., 1982). Throughout this thesis I have argued that the adaptive function of jealousy is the maintenance of the pair bond, since this not only increases the survival chances of individuals, but also of their offspring. Protecting your mate from interlopers is therefore crucial, and those individuals who were the most sensitive to threats to their relationship would have been reproductively more successful. Given this, in this dissertation I have

detailed how in women, attractive rivals evoke more jealousy than unattractive rivals, and also more jealousy than socially dominant rivals. In men, the rival's social and physical dominance is crucial to evoke jealousy. Moreover, using several subliminal priming techniques, I have shown that rivals need not be evaluated consciously for jealousy and a number of other negative emotions to arise: their threat to one's relationship can be assessed literally in the blink of an eye. The present research adds to the literature on sex-specific evaluations of rivals by showing that jealousy is evoked not only through unconscious exposure to words (Massar et al., 2008) or line drawings of body shapes (Massar & Buunk, 2009), but also by exposure to photographs of faces (Chapter 5) or photographs of models wearing costumes varying in status (Chapter 6). Moreover, my findings not only showed that jealousy may be affected by subliminally induced characteristics that were projected on the rival, but also that individual differences affected the attention paid to these characteristics. All in all, I think the findings from my thesis show the flexibility of human behavior and the ability to respond adaptively to specific circumstances. Moreover, I conclude that jealousy is not the negative emotion it is often made out to be – some degree of jealousy might actually be very healthy (and adaptive) indeed.

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Samenvatting

Summary in Dutch

"Anger and jealousy can no more bear to lose sight of their objects than love..."

- George Eliot

Jaloezie is overal – typ het zoekwoord 'jaloezie' op Google in, en binnen 0.07 seconden verschijnen 373.000 hits. De meeste mensen zullen ten minste één maal in hun leven jaloezie ervaren. Jaloezie was en is dan ook een grote inspiratiebron voor schrijvers, filmmakers en kunstenaars. Zo heeft Shakespeare rond 1603 in *Othello* de term 'the green-eyed monster' geïntroduceerd om aan te geven dat jaloezie net een monster is, dat de liefde belachelijk maakt en haar uiteindelijk op zal eten, op de manier waarop een kat haar prooi verslindt. Tegenwoordig wordt jaloezie nog steeds als een negatieve emotie beschouwd en partners die jaloezie ervaren wordt vaak op het hart gedrukt 'het groene monster te temmen'. In dit proefschrift heb ik betoogd dat jaloezie niet alleen maar negatief is – het is een functionele emotie, die zijn wortels heeft in onze evolutionaire geschiedenis waar het ervaren van jaloezie reproductieve voordelen had.

Een evolutionaire benadering van menselijk gedrag gaat er vanuit dat het menselijke cognitieve en motivationele functioneren wordt gestuurd door specifieke en functionele mentale mechanismen die geëvolueerd zijn om adaptieve problemen op te lossen. Met name gedrag, emoties en attitudes die gedurende de menselijke evolutionaire geschiedenis cruciaal waren voor overleving en reproductie zijn doorgegeven aan volgende generaties. Deze benadering gaat er ook vanuit dat sommige emoties de functie hebben om aan te geven wanneer een bepaalde actie ondernomen moet worden – angst roept bijvoorbeeld een sterkte vluchtreactie in mensen op.

In dit proefschrift beargumenteer ik dat jaloezie eenzelfde functie had en heeft, namelijk het individu waarschuwen als de paarband in gevaar dreigt te komen. Deze paarband is niet alleen zeer belangrijk voor de overlevingskansen van het individu, maar ook voor diens nageslacht. Het is dus belangrijk deze relatie te beschermen tegen indringers, en diegenen die daar beter in slaagden waren degenen die de kans kregen hun genen door te geven aan volgende generaties (Maner & Shackelford, 2007; Buunk et al., 2007; Buss, 1989, 1994; Daly et al., 1982). Jaloezie wordt door evolutionair psychologen

dus beschouwd als een basaal, adaptief mechanisme om ontrouw tegen te gaan en de relatie te beschermen. Wanneer er bedreigingen voor de relatie waargenomen worden door de aanwezigheid van werkelijke of ingebeelde rivalen functioneert jaloezie als een signaal-emotie, die aanzet tot actie. Onderzoek heeft uitgewezen dat het al dan niet optreden van jaloezie in belangrijke mate te maken heeft met de eigenschappen van de rivaal (zie bijvoorbeeld Dijkstra & Buunk, 1998, 2002). Met name de factoren die bijdragen aan de partnerwaarde van de rivaal – de eigenschappen die ervoor zorgen dat hij of zij een aantrekkelijke partner zou zijn voor anderen – roepen jaloezie in mannen en vrouwen op (Gilbert et al., 1995; DeSteno & Salovey, 1996; Dijkstra & Buunk, 1998, 2002; Broemer & Diehl, 2004).

Echter, mannen en vrouwen worden niet door dezelfde rivaalkenmerken jaloers. Fysieke aantrekkelijkheid wordt gezien als een kenmerk van de gezondheid en vruchtbaarheid van een vrouw (Buss, 1989; Kenrick et al., 1990; Singh, 1993). Aangezien de kans dat ze hun genen door zullen kunnen geven het grootst is bij een gezonde, vruchtbare vrouw, zullen mannen dus vooral fysieke aantrekkelijkheid in een partner waarderen. Hieruit volgt dat een fysiek aantrekkelijke vrouw voor andere vrouwen de grootste bedreiging zal vormen en de meeste jaloezie zal oproepen (Dijkstra & Buunk, 1998; Buss et al., 2000). Voor een vrouw is vooral belangrijk dat haar partner haar en haar nageslacht zal kunnen beschermen en van allerhande middelen (geld, eten) kan voorzien. Mannen die sociale status hebben – of de eigenschappen om status te verkrijgen – en mannen die fysiek dominant zijn, zijn hiertoe het beste in staat. Deze mannen zijn voor vrouwen de meest aantrekkelijke partners en, logischerwijs, voor andere mannen de meest bedreigende rivalen (Dijkstra & Buunk, 1998, 2002; Buss et al., 2000). In dit proefschrift heb ik betoogd dat het inschatten van de bedreiging die een rivaal voor je relatie vormt van zodanig belang was, dat dit geëvolueerd is tot een automatisch proces. Met andere woorden, rivalen zullen zonder dat mensen er moeite voor hoeven te doen, zelfs zonder dat ze zich er van bewust zijn, worden geëvalueerd en jaloezie oproepen.

Evolutionair psychologen gaan er vanuit dat het categoriseren van sociale stimuli zich heeft ontwikkeld tot een snel en automatisch verlopend proces (Ambady & Rosenthal, 1992; Fetchenhauer & Buunk, 2002), zeker als deze stimuli het individu informatie verschaffen

die zijn of haar reproductieve succes kan verhogen (Maner, Gaillot, Rouby, et al., 2007; Neuberg et al., 2005). Tot nu toe is het onderzoek over de invloed van rivaalkenmerken op jaloezie uitgevoerd door proefpersonen *expliciet* te confronteren met een rivaal, in de vorm van foto's of een persoonlijkheidsbeschrijving (Dijkstra & Buunk, 1998, 2002). Omdat het evalueren van een rivaal zo cruciaal is voor het reproductief succes van mannen en vrouwen, heb ik in dit proefschrift onderzocht of rivaalevaluatie wellicht een *automatisch* verlopend proces is. Mijn hypothese is dat als dit het geval is, dan zouden ook onbewust aangeboden en waargenomen rivalen een effect op gerapporteerde jaloezie moeten hebben. Veel onderzoek uit de sociaal cognitieve psychologie laat zien dat het mogelijk is om proefpersonen te beïnvloeden met stimuli die ze niet bewust waargenomen maar toch hun gedrag, attitudes en emoties beïnvloeden (bijvoorbeeld: Ferguson et al., 2005; Dijksterhuis, 2004; Wegner & Bargh, 1998; Devine, 1989; Fazio et al., 1986). Een manier om stimuli aan te bieden buiten het bewustzijn van mensen is door gebruik te maken van zgn. subliminale priming (voor een overzicht, zie Merikle, 2007). Hoewel deze techniek in sociaal cognitief onderzoek veelvuldig gebruikt wordt, wordt hij bij mijn weten in dit proefschrift voor het eerst toegepast in onderzoek naar jaloezie. Mijn verwachting is dat het mogelijk is om proefpersonen buiten hun bewustzijn bloot te stellen aan een rivaal, en dat vrouwen meer jaloezie zullen rapporteren na blootstelling aan een fysiek aantrekkelijke rivaal – of dat nou is in de vorm van woorden, foto's of lijntekeningen. Mannen zullen meer jaloezie rapporteren na blootstelling aan sociaal of fysiek dominante mannen.

In Hoofdstuk 2 beschrijf ik hoe, naast de kenmerken van de rivaal, individuele verschillen een rol spelen in de hoeveelheid jaloezie die proefpersonen ervaren na het lezen van een jaloezieopwekkend scenario. Meer specifiek is de rol van partnerwaarde en relatiesatisfactie onderzocht. De proefpersonen werden onder het mom van een associatietaak subliminaal blootgesteld aan woorden die ofwel betrekking hadden op sociale dominantie, ofwel op fysieke aantrekkelijkheid. Na deze taak kregen zij een scenario te lezen, waarin alleen het gedrag van de rivaal werd beschreven, zonder details over zijn of haar uiterlijk of persoonlijkheid te geven. Dit scenario werd ontwikkeld door Dijkstra en Buunk (1998) en ingekort voor de studies die in dit proefschrift beschreven zijn. De resultaten wijzen uit dat vrouwen met een lage partnerwaarde jaloerser bleken dan vrouwen met een hoge

partnerwaarde, waarbij de kenmerken van de rivaal weinig verschil maakten. De laatste groep vrouwen gaf aan meer jaloezie te voelen na blootstelling aan de aantrekkelijke rivaal dan na blootstelling aan de sociaal-dominante rivaal. Voor mannen bleek echter de tevredenheid met hun huidige relatie een voorspeller voor de manier waarop zij op de subliminale primes reageerden: Mannen die zich niet tevreden voelden over hun relatie rapporteerden meer jaloezie dan mannen die wel tevreden waren, maar wederom deden rivaalkenmerken er niet toe. Bij mannen die wél tevreden waren met hun relatie speelden de kenmerken van de rivaal wel een rol – zij rapporteerden meer jaloezie na blootstelling aan de sociaal dominante rivaal dan na blootstelling aan de fysiek aantrekkelijke rivaal. In dit hoofdstuk beschrijf ik tevens een studie waaruit blijkt dat de menstruatiecyclus van vrouwen een rol speelt in de beoordeling van rivalen – vrouwen die zich op het moment van het experiment in de vruchtbare fase van hun cyclus bevonden, rapporteerden meer jaloezie na blootstelling aan een fysiek aantrekkelijke rivaal dan vrouwen die niet vruchtbaar waren ten tijde van het experiment.

In Hoofdstuk 3 ligt de nadruk op mannen, en op individuele verschillen in 'sex drive' (libido). Ik beargumenteer in dit hoofdstuk dat de mannelijke sex drive als een uiting van een bepaalde reproductieve strategie kan worden gezien. Mannen verschillen in de mate waarin zij gericht zijn op het verkrijgen van meerdere partners voor korte seksuele relaties, en de mate waarin zij gericht zijn op het verkrijgen of behouden van een relatie voor de langere termijn (Gangestad & Simpson, 2000). Ik beargumenteer in dit hoofdstuk dat mannen die een hoge sex drive hebben, zich eerder op de eerstgenoemde strategie zullen richten, terwijl mannen met een lage sex drive eerder de tweede strategie volgen. In het experiment dat ik beschrijf zijn mannen wederom subliminaal blootgesteld aan woorden, maar deze keer werd een *context* geprimed – ofwel een seksuele context, ofwel een context die gevoelens van verbinding opriep. Hierna werd hen gevraagd hun mening te geven over een rivaal die hoger scoorde op een aantal kenmerken. De resultaten lieten zien dat mannen zich meer door een rivaal uitgedaagd voelden als ze geprimed waren met een context die 'paste' bij hun gevolgde reproductieve strategie. Mannen met een lage sex drive voelden zich meer bedreigd door de rivaal in een verbintenis context, mannen met een hoge sex drive juist in de seksuele context.

In Hoofdstuk 4 ligt de nadruk op fysieke aantrekkelijkheid en wordt ook de rol hiervan voor de partnerwaarde van mannen besproken. Een 'optimale' verhouding tussen de taille en de heupen van 0.7 wordt bij vrouwen geassocieerd met gezondheid en vruchtbaarheid (zie onder andere Furnham et al., 1998), en in onderzoek is bovendien gevonden dat dit zandlopermodel het meest aantrekkelijk gevonden wordt (Singh, 1993). Bij mannen wordt een figuur dat eruit ziet als een omgekeerde driehoek, dat wil zeggen een schouder-heup verhouding van 1.4, het aantrekkelijkst gevonden. In dit hoofdstuk is gebruik gemaakt van lijntekeningen – dit zijn abstracte tekeningen van mannelijke en vrouwelijke figuren met een variërende verhouding tussen ofwel de schouders en de heupen (de SHV – schouder-heup verhouding) ofwel de taille en de heupen (de THV – taille-heup verhouding; Singh, 1993). Deze lijntekeningen zijn wederom subliminaal aangeboden aan de proefpersonen, en na het lezen van het jaloezieopwekkende scenario is hen gevraagd hoe jaloers ze zich voelden. De resultaten laten zien dat fysieke aantrekkelijkheid ook voor mannen een rol speelt: mannen rapporteerden meer jaloezie na blootgesteld te zijn geweest aan de fysiek aantrekkelijke rivaal dan na blootstelling aan de fysiek minder aantrekkelijke rivaal. Voor vrouwen werd hetzelfde patroon gevonden.

Hoofdstuk 5 en 6 ten slotte hebben gemeen dat er gebruik is gemaakt van foto's om de rivaalkenmerken aan de proefpersonen aan te bieden. In Hoofdstuk 5 wordt beschreven hoe de aantrekkelijkheid van gezichten de jaloezie van vrouwen beïnvloed. Over wat een aantrekkelijk gezicht is, is grote overeenstemming tussen verschillende culturen (voor een overzicht zie Langlois et al., 2000). Bovendien is gevonden dat zeer jonge baby's al een voorkeur hebben voor aantrekkelijke boven onaantrekkelijke gezichten (Slater et al., 2000). Deze en andere onderzoeksresultaten wijzen er op dat een aantrekkelijk gezicht een signaal van gezondheid –en daarmee vruchtbaarheid – kan zijn. Rivalen met zeer aantrekkelijke gezichten zullen daarom zeer bedreigend zijn. Om te onderzoeken of dit inderdaad zo is, zijn de vrouwelijke proefpersonen in Hoofdstuk 5 ofwel aan een zeer aantrekkelijk, ofwel aan een zeer onaantrekkelijk gezicht blootgesteld. De resultaten zijn eenduidig: vrouwen die het aantrekkelijke gezicht hadden 'gezien', rapporteerden meer jaloezie dan vrouwen die blootgesteld waren aan het onaantrekkelijke gezicht. In Hoofdstuk 6 zijn de proefpersonen blootgesteld aan foto's van mannen en vrouwen die kleding droegen die aangaf dat zij een hoge of lage status hadden. Zoals al

eerder beschreven is, wordt vanuit evolutionair oogpunt verwacht dat status voornamelijk voor mannen een bedreigend rivaalkenmerk zou moeten zijn. Dat dit door kledingkeus kan worden gemanipuleerd, bleek uit onderzoek van Townsend en Levy (1990b). Deze onderzoekers toonden aan dat de kleding die een mannelijk model droeg, meer invloed had op zijn aantrekkelijkheid als partner voor vrouwen dan zijn fysieke aantrekkelijkheid. De vrouwen in dit experiment kozen consequent voor de hoge status man, ook al was hij fysiek onaantrekkelijk. Ik verwachtte dan ook dat in het experiment dat in Hoofdstuk 6 wordt beschreven het model met de hoge status kleding de meeste jaloezie in mannen zou oproepen, terwijl voor vrouwen geen verschil tussen condities zou worden gevonden. Verder heb ik in dit hoofdstuk aandacht besteed aan individuele verschillen in obsessieve jaloezie, ook wel partnerbewaking genoemd. Personen die obsessief jaloers zijn, verliezen hun partner liever niet uit het oog en willen niet dat hij of zij contact heeft met personen van de andere sekse. De resultaten uit deze studie laten zien dat personen die sterk aan partnerbewaking doen, meer jaloezie rapporteren dan mannen en vrouwen die lager scoren op deze vragenlijst. Verder werd gevonden dat de stimuli voor vrouwen geen effect hadden – de status van een rivaal beïnvloed de mate van hun jaloezie niet. Voor mannen werd echter een effect gevonden dat tegengesteld was aan de verwachting: zij rapporteerden juist bij een lage status man meer jaloezie dan bij een hoge status man, vooral als zij sterk aan partnerbewaking deden. In de discussie van dit hoofdstuk ga ik in op mogelijke oorzaken voor dit effect.

Conclusie

De conclusie die ik uit de studies in dit proefschrift wil trekken is dat het inderdaad mogelijk is om jaloers te worden door een rivaal die je niet eens bewust hebt gezien. Gezien het centrale belang van rivaalevaluatie voor het reproductieve succes van mannen en vrouwen, is het aannemelijk dat dit zich heeft ontwikkeld tot een automatisch verlopend proces. Elke keer als een rivaal ten tonele verschijnt wordt hij of zij automatisch op zijn of haar bedreiging voor de relatie ingeschat, waarna de sterkte van de jaloezie die optreedt bepaalt of – en welke – actie wordt ondernomen. De resultaten van dit proefschrift laten bovendien zien dat jaloezie niet alleen wordt beïnvloed door de subliminaal aangeboden

stimuli die op de rivaal werden geprojecteerd, maar ook dat theoretisch relevante individuele verschillen – zoals partnerwaarde of libido – bepalen *hoeveel* aandacht wordt geschonken aan deze kenmerken.

Dit proefschrift heeft naast een sterk evolutionair psychologisch karakter, ook een sociaalcognitieve smaak. Het gebruik van methoden uit de sociale cognitie om hypothesen uit de evolutionaire psychologie te testen biedt naar mijn idee zeer veel mogelijkheden voor toekomstig onderzoek. Ik hoop van harte dat door het gebruik van deze beproefde methoden een deel van de kritiek op de evolutionaire psychologie weg zal worden genomen. Ik ben van mening dat de resultaten uit dit proefschrift laten zien hoe oeroude 'instincten', in combinatie met persoonlijkheidsverschillen en situationele factoren de flexibiliteit van het menselijke gedrag bepalen. Jaloezie is niet zo naar als de meeste mensen denken – een bepaalde mate van jaloezie kan zelfs zeer gezond (en adaptief) zijn.

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Karlijn
Mei 2009

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